Booklet Series No. 2.

Bamboo, and its Uses in China

By Willard M. Porterfield Jr.,
St. John's University, Shanghai

Chinese Government Bureau of Economic Information

Head Office:
1-A Chang Pu Ho, Nan Ho Yen, Peking.

Shanghai Office:
20 Museum Road, Shanghai.

Bamboo, and its Uses in China.

Contents.

		Page
Chapter I.	Introduction	1
II.	The Nature of the Plant and Its Cultivation	5
III.	The Distribution of Bamboo	17
IV.	The Properties of Bamboo	29
V.	Uses of Bamboo	35
VI.	The Trade in Bamboo	55
	Appendices	61

Illustrations, Tables, Lists, and Maps.

Chapter I: Introduction

Three million Haikwan taels, or approximately U. S. $2,000,000, represent approximately the yearly trade of China in bamboo, bambooware, and bamboo shoots as accounted for by the Maritime Customs Reports. As one of China's chief products, it takes a place alongside silk, cotton, hides, pig iron, paper, tea, and oils (bean, peanuts, and wood). The above figure includes the net import of bamboo in the open ports, as well as the figures for the amount of export to foreign countries.

Though the other products are used in China in varying degree, none of them is put to such a variety of uses or appears in so many forms as bamboo. In this respect bamboo is absolutely unique. Even the manufacture of paper is dependent to a great extent on bamboo supplies. Bamboo provides the pulp for a big proportion of writing paper, as well as for other grades. Silk is merely a fabric, and a luxury. Iron is used locally in many ways and for a number of useful articles, but a great deal is also imported in the form of machinery. Many articles now made of iron were formerly made of bamboo. There is a tremendous local cotton business, but Japanese and American cotton goods manufacturers are formidable rivals. The import of cotton goods has been very heavy. Tea is simply a beverage, and can never be anything else. Native vegetable oils have a local value, as adulterants, if for nothing else, but they serve no useful purpose unless combined with other articles. Finally, there is a steady procession of hides out of the country, native manufacture being strictly limited. Leather is not all important, and imports are relied upon by the Chinese dealers.

Bamboo, however, by contrast with these others, takes a place occupied by no other product. No bamboo is imported into China. The trade is entirely internal, or directed outward to foreign countries. Bamboo seldom if ever finds its way back to China in one of its multitudinous guises as an import.

The figures for the net import into the treaty ports do not tell the whole story of its extensive use in China or its usefulness. From the financial standpoint, they do not take into consideration the large trade through the native customs, nor the local village trade near the places where the poles are cut. If to this could be added in money an amount which would truthfully represent the marginal utility of bamboo, the present figures for its

trade would be increased far and away above those for silk or any other leading Chinese product. Unlike the other commodities, the ways in which bamboo are employed are not confined to one sphere. Its uses are not limited to building and construction only, but to miscellaneous uses, including the making of toys, implements, furniture, paper, even food and clothing.

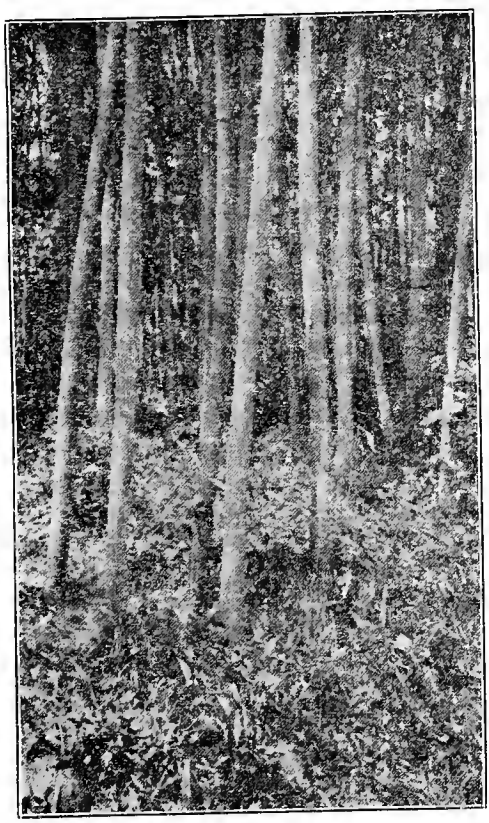
It is our purpose in the following pages to outline as far as possible all phases of bamboo, particularly as related to the economics of China. We shall attempt to give the economic interpretation to all bamboo phenomena. To do this we feel that our own experiences are insufficient. We wish, therefore, to supplement them by drawing on the knowledge of those older in China experiences and in more intimate touch with her resources. From the books of those who know, from conversations with others who are finding out, and from our own beginnings, we have tried to extract the constituents wherewith to build a bamboo lore.

It is impossible to say when bamboo was first used by man. Doubtless its history runs back to the beginning of civilization in Asia, which may also mean the beginnings of all things human or related to humans. Velenovsky claims that the plant flourished in the Cretaceous Age, just before the opening of the Tertiary, when the first men appeared. That man and bamboo have been closely associated in China from prehistoric times has support in the fact that one of the simple radicals, or elements of a Chinese ideograph, is a picture of bamboo, *chu*, 竹. Though now considerably conventionalized and abbreviated after the long lapse of time, there is still unmistakable evidence that the character for bamboo was meant to be a picture of two canes side by side, each with branches and leaves. The ideographs were originally built up of picturographs or pictures of objects for which the spoken language had names. For instance, 木, meaning a tree, is a picture of a tree with trunk, roots, and branches; and 林 means a forest. You see it is the plural of 'tree'. The latter is an ideograph. These picturographs were evolved in the days when *Ku Wen*, 古文 or the Ancient Learning, was in its infancy. The Chinese ascribe the invention of the *Ku Wen* characters to Ts'ang Chi, a four-eyed minister who served Huang Ti (B.C.2,600). The invention of a character specially to signify bamboo implies the established role it had already played in those times, a fact which in itself places the beginning of the knowledge of bamboo and its uses at an even earlier date.

Bamboo not being within the easy reach of Western science has never attained the prominence obtained by less famous plants. Some men have indeed made careful studies from time to time, and it is mainly due to their efforts that Westerners know anything at all about the plant. According to the present state of knowledge in China, bamboo has been thoroughly exploited. In art, in philosophy, in trade, in popular knowledge, it has run the full gamut of all its uses, but in science in China as in the West bamboo offers refreshing mystery. The authoritative works available to the Westerner were written ten years ago, some twenty or more, so that one feels in

consulting them like a person looking up an historic character as described by a contemporary. To one living in China where bamboo is so common, this condition of affairs seems strange and out of all proportion to the investigating spirit of modern science. In the current journals some very interesting accounts and discussions concerning bamboo have occasionally appeared, such as Seifriz's articles in the "*American Journal of Botany*" on "Gregarious Flowering", etc. and those by other men which have been published in the past in such journals as the "*Philippine Journal of Science,*" the botanical garden publications from Java and Ceylon, and the "*Indian Forester*", not to mention French and Japanese papers. Except for the first mentioned investigator, however, one is impressed with the gap in time that exists between these articles and the present. Is there a lack of interest? If so, why?

As this is not to be a botanical exposition of bamboo, the present remarks might seem to be irrelevant. But this is not quite so. We are hoping that the contents herein contained will call attention to bamboo sufficiently to stimulate some adventurous investigator to go in pursuit of further knowledge. For not only is bamboo as such a fascinating subject in its purely sociological relations, but it is remarkable as a plant and offers splendid material for investigation and possible solution of many problems interesting to the biologist. The nomenclature of bamboo is in an exceedingly backward state. Even the physicist and engineer who are looking about for cheaper material wherewith to reinforce concrete may find something to engage their interest. Obviously, investigations of a scientific nature are of great value, for they divulge facts about the plant which will be useful in its further exploitation for economic purposes.



A bamboo forest

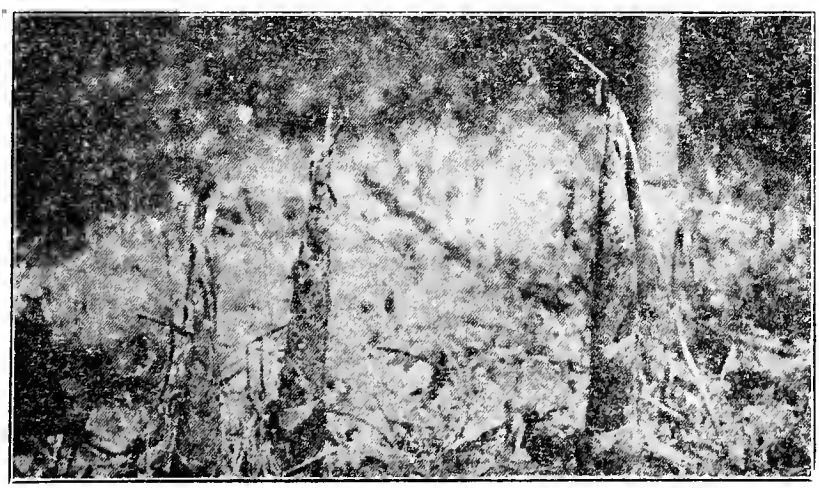
Financially, bamboo is a good investment. The returns are large as compared with the small amount of trouble and expense necessary in its cultivation. Since the life of most bamboos is very long, one is not troubled with anxiety about the prospects of the forthcoming crops at every stage of growth from the planting season to the time of harvest. Bamboo simply goes on producing year after year,

The discussion in the following chapter on the nature of the plant may shed some light on this aspect. Since bamboo is so wide spread in China, it is not necessary to travel far to see it or to obtain samples as is the case with most raw materials. The distribution of bamboo in general, and of the various kinds of bamboo in particular, is important information for both the economist and the ecologist. The new map attached to and containing the results of this study seeks to localize bamboo only in places from which definite information has been obtained. This is followed by an analysis of the properties of bamboo. The uses of bamboo are the logical outcome of its nature and properties. The description of them is as full as we could possibly make it, in order to show to what extent bamboo is an economic factor in the lives of the Chinese. At the end is a summary of the trade in bamboo, bambooware, and bamboo shoots for the past ten years, with a comparative view of the production by provinces which ought to suffice to establish permanently the reputation of bamboo as the universal provider.

Chapter II: The Nature of the Plant and Its Cultivation

In order more thoroughly to know and appreciate bamboo, one must consider the nature of the plant. Though we wish to avoid any unnecessary references of a purely botanical character, we feel it is almost impossible to impart an understanding of the economic factors that enter into its cultivation without first entering into a discussion of some of its more important characteristics.

In the first place, bamboo is a tree-grass. It possesses all the essential characteristics that mark a grass. A brief analysis will suffice to establish the fact. We must expect from it, therefore, the behavior and habits peculiar to grasses, creeping grasses especially. At this point let us consider a matter of terminology. It is customary to refer to the standing canes and poles of bamboo as *culms*. It may have been noticed that the standing culms of some bamboos form dense clumps, while others stand more or less widely separated in groves and forests. Morphologically, culms are not stems. Unlike the culm, the real stem is practically solid, and grows into a tortuous many-branched system that spreads beneath the surface of the ground in all directions. From its joints on alternate sides spring the jointed hollow culms like branches of a tree. The stem is generally called a *rhizome*. The elongation and branching of the rhizome continues year after year; and in this way the forest grows in extent.



Bamboo shoots coming up out of the ground

Roots radiate from the nodes of the rhizome and also from the base of the culms. Everyone who has lived in the Far East or the tropics is familiar with the characteristic jointed appearance of bamboo, the branched upper parts, and the waving plumes of foliage, so that no further discussion along these lines is necessary. The particular point we wish to make from these few statements is that owing to the physical connection between many culms, sometimes between whole forests, the bamboo is a very large and very extensive plant. If an entire forest is to be considered one plant, naturally the treatment accorded it will from this point of view differ from that based on the conception that separate culms are separate plants. This fact is of obvious economic significance.

The reasons for this statement may be made clear with a few illustrations arising from scientific investigation. It is clear from our premise that what affects one part of the plant is likely to affect the whole. Passive environmental conditions, however, must be excluded because, being prevalent generally in any one region, they act equally on all animals and plants in that region, and, therefore, if species will respond to those conditions similarly in greater or less degree regardless of individuality, the fact of whether or not in the case of bamboo the culms are individuals or part of a physiological whole is not demonstrated. Too extensive cutting of the culms, though immediately affecting only individuals, results in the general production of smaller shoots and smaller culms. A good example of this may be seen on the hillsides of Mokanshan, in Chekiang province, particularly on the foreign properties. As this is a summer colony, the place is deserted in winter, being left in the hands of a few Chinese caretakers who make something on the side by selling canes cut from these places. The culms as a result become smaller each year, averaging not over three inches in diameter, while those of the same species in other localities, where the thinning process has been carried out with care, average five to six inches. In any producing district, if the former is the practice, there will result an economic loss which can only be compensated by a change of treatment. Fairchild in his interesting account of bamboo forest culture in Japan explains that scientific cutting throws the strength of the plants into a comparatively few large culms and gradually increases the height and strength of the forest. This certainly points to the physiological unity of the grove and must be considered in any economic discussion.

Another economic factor of importance in the life-history of bamboo is the extraordinary rapid growth of the culms. Bamboos vary in height from a few feet to 100 and 120 feet. An example of the latter is the giant bamboo, *Dendrocalamus giganteus*, of the Asiatic tropics. A tall deciduous forest tree or a giant conifer takes two or three hundred years to grow to similar proportions, but it is a fact that a single culm, depending on the kind, will reach its full height in from 40 to 60 days. Indeed the growth-rate is so rapid that it is measurable by the hour. Lock in his measurements of

the growth-rate of giant bamboos says that the greatest growth observed for 24 hours was 46 centimeters, while the greatest recorded growth per hour was 23 millimeters. Growth was found to be more rapid by night, and seems to be at all times affected by external factors, rainfall, temperature, and wind. The curve of growth by day follows closely that of the percentage of moisture in the air.

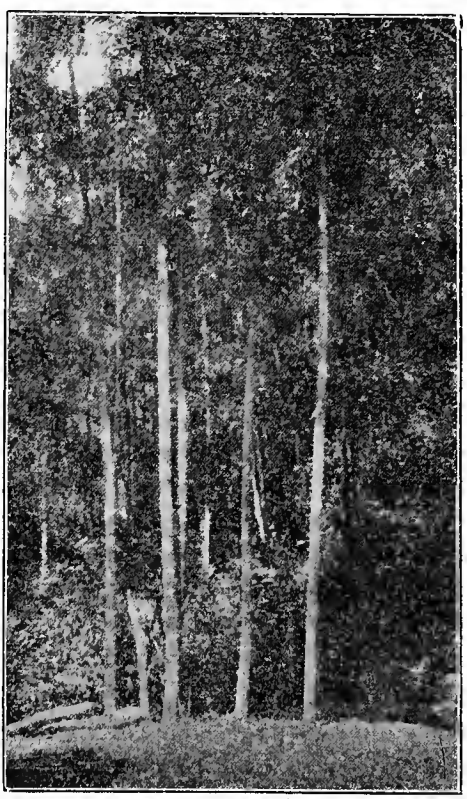
The conical bud when ready to spring upward from the node of the rhizome swells until it is thicker than the rhizome. Because of its tender character, it is well protected with sheathing bracts, which originate from the joints already formed within the bud. The thickness of the bud at its widest part is an indication of the probable diameter of the future culm. In the shoot the nodes seem to be the first parts developed. In a longitudinal section they are seen to lie flat one on top of the other like a pile of plates, with the pith between them larger and thicker on the bottom and tapering off to the smaller and thinner at the top near the growing point. When elongation commences, the growth activity is centred entirely in the internodes, all internodes taking part for a time nearly simultaneously but in ascending order, the lowest as usual completing its growth first. As the nodes draw away from each other, the pith breaks, and the characteristic hollow spaces of the internodes develop. It is this co-operative growth of the internodes which brings about the tremendous upward push of the shoots. Just as remarkable is the fact that before a culm has attained its height, its diameter has already been determined; in fact, not six inches behind the growing point may its final thickness be observed. Beyond this point growth is in one direction only. The size of the culm, therefore, cannot be said to increase with age.

As each internode reaches its full length, the sheathing bract generally drops off, exposing the dark green culm. The wood is soft and may easily be cut with a knife. If cut down at this stage, however, the culm will dry out, shrinking to a more shell and badly warping at the same time. This is because it is 80 per cent water. In three to five years the fibres of the culm, if left, will harden sufficiently to allow of cutting. To insure perfect preservation of form and strength, it is better, however, to wait until the culm turns yellow. This may take ten to twenty years, depending on the kind of bamboo. Of the many useful and interesting characteristics already mentioned, its rapid growth is perhaps the most economically important, as well as the most surprising.

The last though not by any means the least important fact of its life history which has a real economic bearing is its habit of gregarious flowering. Some bamboos flower annually or sporadically here and there, but a great many burst simultaneously into flower over the whole countryside, and only after an interval of many years. The flowering itself is not so important as the events which follow it. After a simultaneous flowering the entire crop of culms from the youngest to the oldest turns yellow and dies. It is a sign of maturity hastened into expression by favorable environmental factors. This

simultaneity is due to the fact already brought out, namely, that the whole forest is one plant. There may be a preliminary flowering of a few culms; then the entire forest bursts into bloom. As a grass it follows the habit of grass. Wheat, oats, barley live a vegetative life for a time; then they reach maturity, flower, and die.

Let us first consider the economic importance of the flowering. Perhaps its most important aspect is the production of seed. It may either fall to the ground to produce new rhizomes and a few years later a new generation of normal-sized culms, or it may be gathered and eaten like rice. In the natural course of things, the first alternative takes place. Thousands of seeds fall to the ground and the surviving seedlings eventually develop indepeadent rhizome systems which interweave with adjacent rhizomes. The seedling culms of the first year are small and whip-like, giving place in the following years to increasingly larger ones till finally the characteristic size is reached. But it must be borne in mind that it takes three to five years for this to take place, and in the interim the bamboo industry of that particular region is inactive. Either bamboo must be imported or the people must wait for the flowering.



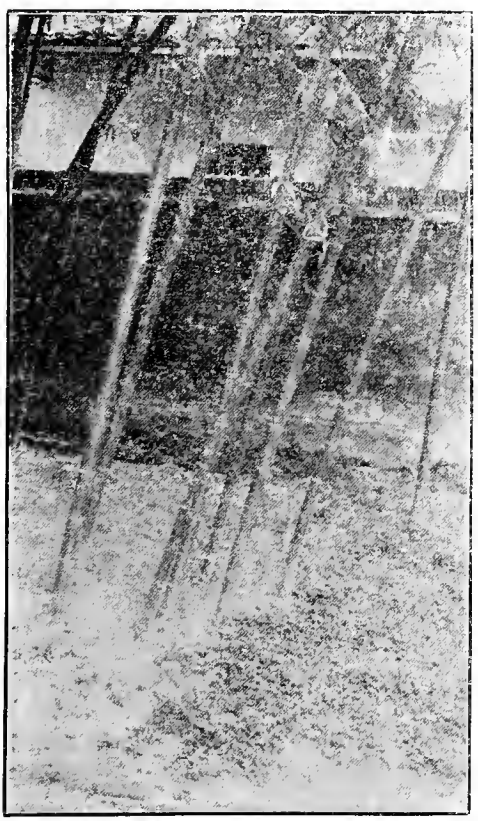
Mao Chu, 毛竹 Phyllostachys pubescens growing

In China and India there is a saying to the effect that bamboo flowers only when there is going to be a famine so that the people may come to gather the seed for food. Aug. Henry tells of an incident about thirty years ago which happened near Ichang. During a visit to that district he came upon quantities of dead canes standing in a large tract of coniferous forest. He was informed that this particular species had flowered three years before and produced seed which had been gathered by the mountaineers and used as food. Mr. Shaw Stewart, the collector of Canara on the Western Coast of India, states that in 1864 there was a general flowering of the bamboo in the Soopa jungles, and a very large number of persons, estimated at 50,000, came from the Dharwar and Belgaum districts to collect the seed. Each party remained about ten to fourteen days, taking away enough for their own consumption during the monsoon months, as well as some for sale, and adds that "the flower-

ing was a most providential benefit during the prevalent scarcity." A student reported that six years ago in Hunan in the district of Hung Shan Hsien (衡山縣), there was a famine, but the bamboo flowered and saved the people. Enough was gathered for food and some in addition for sale in the markets.

There is, however, another less happy side to this wholesale production of seed. Hackel reports that calamity as well as benefit may follow in the wake of a general flowering of bamboo. He says that in Brazil as well as in India, the sudden production of great masses of rich grain in widespread localities serves to increase the available food-supply for rats and mice to such an extent that they multiply to extraordinary numbers. After consuming all the fruit of the bamboo they naturally overflow into the neighboring fields and devour the crops. The German colonies in Rio Grande du Sul and Santa Catharina were visited by this plague at intervals of about thirteen years, which apparently represents the periodicity of the particular species covering that region.

It is evident that as a rule bamboos do not flower often, but require many years to mature, after which they flower and die. Those which do not exhibit gregarious flowering may have had their periodicity disturbed by certain external factors which in one case retarded and in another hastened it. Upon close analysis, however, it would be seen that the characteristic periodicity in the case of individual plants was still maintained, that the seeming breakdown of periodicity was due to the presence of several different plants of the same species. Hereditary specificity combined with response to external conditions may account for this. The extensive overlapping of flowering periods serves to keep up the illusion. The remarkable phenomenon of gregarious flowering is the most convincing evidence of the physiological unity not only of the immediate bamboo forest alone, but also of such cuttings and offshoots that may have been taken away. Messrs. A. and C. Rivière relate an instance of comprehensive gregarious flowering in Europe. In 1867 flowers began to appear on two clumps of Arundinaria japonica in the Bois de Boulogne. At the same time they were noticed on the



Phyllostachys bambusoides in a garden

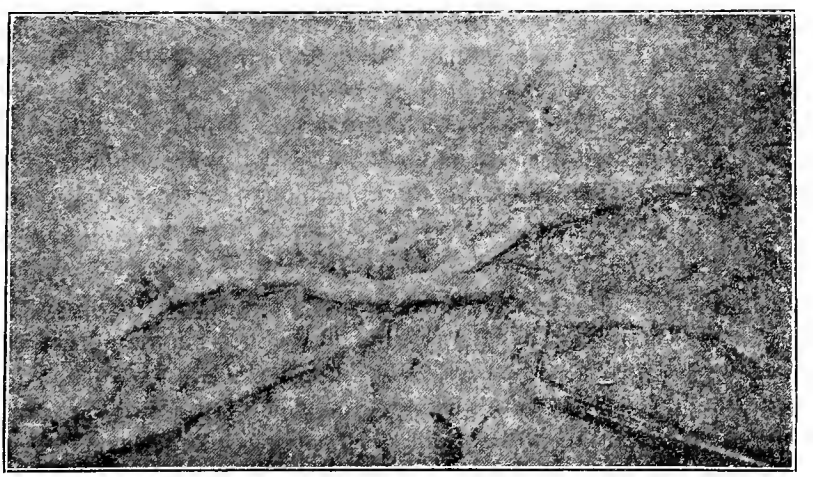
same species in the nursery gardens of Messrs. Thibaut and Keteleer at Sceaux, at Marseilles in the pleasure grounds of M. Paulin Talabot, and in other European collections. Stranger than this, across the Mediterranean the plants of A. japonica in the Government gardens of the Hamma at Algiers were observed to be flowering; not only the old canes but the young shoots also. It was found upon investigation that the whole of the plants then in cultivation in Europe and at Algiers were but off-springs of the parent plant introduced by Siebold in 1850. There are other instances reported. Sir Joseph Hooker states that cultivated plants of Chusquea abietifolia, a climbing bamboo, flowered at Kew gardens simultaneously with the wild ones of Jamaica. In China the same thing has doubtless happened, but accurate accounts are not available, or at least have not yet come to light. It is remarkable how far-reaching the effects of a single flowering may be.

Though the rhizome usually dies with the culms, there are many instances recorded where it has not been entirely exhausted by flowering, but has recovered in certain parts sufficiently to put forth new shoots and begin anew. This dos not do away, however, with thee dearth of building materials consequent upon the flowering of the bamboo. Just the same, it makes the people realize what part bamboo plays in their lives. The wiping out of a bamboo forest by whatever means is a real loss, and its recurrent happening must be looked upon as an economic factor in the business and domestic life of the community. Nevertheless, it must not be overrated. It is only a temporary loss, and then again the event is comparatively rare. Some of the intervals are 10, 15, 30, 32, 35, and 60 years, according to the species, in comparison with which the life of man amounts to but little more. During his life he stands one or two chances at the most of experiencing a general flowering of his crop of bamboo. In general, nothing much is said about it, or the scarcity of data on the flowering periods of our bamboos would not be so evident. In buying land the question of whether the bamboo crop may be a total loss next year does not enter into the negotiations. At the time of the flowering, however, one can scarcely overlook the fact that the loss involved is a most inconvenient handicap to the community.

Given a tract of land that is covered with a good stand of bamboo, the Chinese farmer shows his regard for his forest wealth by taking particular pains to mark each culm with his Chinese character to insure at least a nominal immunity from theft. If he gave as much thought, however, to the cutting of shoots and culms as he does to the preservation of his personal property, he would reap a crop of canes that in size and value would more than pay him for his extra trouble and anxiety. What is really needed is an improved forest technique for bamboo, as carefully worked out as it is for the deciduous and evergreen forests of Europe and America. This is necessary in order to preserve a maximum growth and constant supply of culms. Owing to the tremendous demand for bamboo, it is perfectly

natural that the farmers should seek to satisfy that demand, just as far as it is to their advantage to do so. With trade coming their way, the temptation to extend their cutting to younger culms in order to send down to the market a larger number is too strong, and the result is overcutting. This is decidedly weakening to the plant, as the leaf-bearing culms are its synthetic organs. There is a zero point in the relations between the production of new shoots and the cutting of old culms beyond which the farmer cannot go without impairing the normal life of the plant. It is impossible to keep up the production of normal full-sized shoots when cutting goes beyond the zero point and upsets the balance. It is the old problem of commercializing natural resources without regard for the future. In this case, however, our attitude must be more concerned than that of the men who have watched with regret the passing of the great forests of North America through ruthless cutting. With the ordinary deciduous or coniferous forest the treatment of an individual tree does not injure those standing by; if anything, its removal is an advantage, since, as a result, there is more light, more space, and more available supplies of food materials in the soil. But as has been stated, the nature of the bamboo plant demands that less casual attention be paid to the cutting; that since a single culm is but a shoot of a far-reaching plant, intelligent principles be used in handling that culm, lest the whole forest suffer.

There is good evidence that this is a fault regularly displayed by the Chinese farmer, and the effects may be observed by anyone interested enough. Two patches only are known on the whole of Mokanshan, near Hangchow, Chekiang province, where Phyllostachys pubescens, locally known as Mau tsok, 毛竹, the largest lumber bamboo in the Yangtse valley, has reached its finest development; one is in the Mt. Clair district on the Tucker property, the other is on the south slope of the mountain beyond the Camp. The culms in these groves average five to six inches in diameter, but they are positively watched and guarded. Over the rest of the hillsides



A rhizome sometimes crawls along the surface of the ground like a snake, in sinuous curves. (Ph. pubescens)

the culms though labelled are undersized, averaging at most two to three inches in diameter; and stumps are everywhere to be seen. Furthermore, these stumps by measurement indicate that the culms which in the past stood in their places were thicker. The region round Shanghai is not essentially bamboo-growing country,but there are many isolated groves,chiefly of Phyllostachys bambusoides, which are productive. These show the same trend as the others, but in lesser degree, probably because we are here dealing with a smaller bamboo. The fault lies not so much with the farmer as with the agent to whom he sells his standing crop. The latter cuts the whole lot, leaving only a few undersized culms to carry on until the plant can recuperate and re-establish itself. After four years he will begin cutting again, and then after the grove has grown beyond his own needs, he again contracts for the whole stand. One must consider also the annual picking of the early shoots as or before they appear above the ground. These are good to eat and are sold in the markets for a good price. Altogether, we have a grove which promises well but never produces more than undersized culms. The explanation is over-cutting.

There is one further illustration of the effects of over-cutting. It is a regular practice in green-houses where bamboos are grown in tubs or pots to cut back not only the culms but also the rhizome, so that the culms may not become too large. Clumps of bamboo growing on restricted areas in the garden are treated by force of necessity in the same way, with always the same result.

Some mention has been made of the cutting of bamboo shoots. The young shoots of some bamboos are very edible, and they form one of the chief items of vegetable diet in the Far East at certain times of the year. They possess a crisp juicy flesh, like that of a potato or of certain kinds of apples. Foreigners in the Orient enjoy them as much as the Chinese themselves. In fact, the demand for shoots has grown so much that canning factories have been established at Ningpo and Amoy. Now bamboo shoots may be enjoyed at any time of the year. Annual exports of bamboo shoots from Foochow to Amoy are estimated at 80,000 catties. The current price is about $2.50 per 100 catties. Like eggs in China, all shoots gravitate toward the tinning factories. The temptation to the farmer is obvious, and the result is increasingly smaller shoots, as in the case of the culms. Therefore, in considering better methods of cultivation in China to increase the production of bamboo and to secure greater benefit thereby to the country, the question of cutting must be considered seriously.

To sum up, cutting should not be for the sole purpose of obtaining an immediate return. Some thought should be expended on the future. Cutting should therefore be in the nature of a thinning process. Just as appropriate trimming and pruning will increase the yield of certain trees, so with bamboos scientific cutting will not only in time yield a large immediate crop, but also by throwing the strength into fewer culms will gradually increase the height and strength of the forest, and will assure an increased yield for

the future. In the scientifically treated groves of Japan and elsewhere, all shoots that are left to grow up are labelled with the year so that the age of the culm in each case is known and none are cut down before they are hard. The proper age for cutting is eight or nine years. When a recently planted grove of bamboo becomes thick and dense, that is not necessarily the time to begin cutting. Some thinning may have to be done, but ordinarily the grove does not begin to produce before eight years. After that time if accurate records of the ages of the culms have been kept, the cutting of them alone will have effected a sufficient thinning.

In regard to cultivation, the native practice in China deserves attention. In the Yangtse valley as the winter draws on and the wheat has been successfully started, the farmers turn their attention to various side-lines and specialties. In some villages it may be basket-making, in others, the weaving of certain kinds of figured silk. But among the various duties performed during the slack season which are more or less cognate to the business of farming, are the raising of winter vegetables and the cultivation of the bamboo patch. The soil over the area occupied by the bamboo is dug up and the clods of earth pulverized after which fertilizer is put on. The fertilizer most used is creek mud. During the low tides of winter and the accompanying dry season the water in the ponds and canals is very low. The bottom mud of these ponds is very rich in necessary mineral food-making substances; so by using it, the farmer not only gets a good fertilizer but also secures the extra advantage of ponds dredged clear of the muck which has silted down into and nearly filled them during the rainy seasons. Manure fertilizers are also used with success. Horse and cow manure is also worked into the ploughed up earth and afterward covered with leaves in some of the foreign garden and parks. This protects them from frost in winter and, by preventing evaporation, keeps the underground stems moist in summer. One chemical fertilizer has been approved for bamboo cultivation. The formula for this compound is as follows: three parts superphosphate of lime, one part ammonium sulphate, and one part calcium sulphate. Five hundred kilograms are sufficient for one hectare, which is a little over two acres. The application, however, must be made three times; the first time around February 10, the second time when the shoots are about three meters high, and then a month later.

We come now to the important subject of the propagation of the bamboo. Propagation is accomplished in four different ways: first, by the natural way, by seed; second, by division; third, by cuttings at the base of the culm with or without the rhizome attached; fourth, by cuttings of the rhizomes. A fifth process, propagation by layering, is available in the case of the autumn-growing or tender bamboos.

Propagation by seed, although the natural method, is the least efficient. In the first place, the intervals between flowering periods are usually so long that seeds are rare. If the spread of bamboos had depended entirely on seed distribution, there would have been considerably fewer groves than

now. Furthermore, they would have been crowded out by the more recent and more quickly-maturing plants. In the second place, the ravages of rodents as described above and the tremendous gathering of the seeds by the people reduce the possible productivity. The seedlings succeed best if they can be sheltered and cared for, but in nature the chances for this are rare and accidental, and consequently what is not scratched up by animals or trodden down by men may wither from lack of moisture, poor light, or deficient soil. Undoubtedly quantities of seedlings do survive and produce forests, a phenomenon which has been witnessed by many observers, but even then it takes years for the embryo forest to become truly productive. From the economic standpoint this is hardly a desirable method of propagation.

The second method, that of multiplication by division, is the one carried out locally in the Yangtse valley, where the distance over which the divisions are to be carried is not great. The process is simple enough. A clump of two culms one or two years old with a length of connecting rhizome is lifted with as much earth as can be carried and planted direct on a new site. With proper moistening and top-dressing with manure and leaves, the buds on the nodes of the rhizome or at the base of the culms will grow and produce new culms and new rhizomes in the next spring. If twenty or thirty pairs of these culms are planted out at distances of two feet, a whole forest can be started immediately, and in four years the new rhizomes will be spreading out, becoming entangled in an extensive underground mat, and sending up normal culms which in a short time will be ready for use. The economic saving is obvious. Whereas three or four years are wasted in developing and establishing rhizomes from seeds before even fair-sized culms begin to appear, and that only after an infrequent periodical flowering, from transplanted divisions with a rhizome already present and buds already formed the preliminary periods of development are eliminated. In other words, we start with something and time is saved. Moreover, divisions and cuttings are likely to be more vigorous. A still more important consideration is the fact that we do not have to wait for flowering to take place. Usually about the ninth or tenth month of the Chinese calendar is the season for this kind of propagation.

In the vicinity of Luchow in the province of Szechwan bamboos are propagated by cuttings of the base of the culm with the rhizome attached. This is usually done before the shoots come up. A short section of one or two year old rhizome is dug up with one young culm attached, which is cut off five feet from the ground. The underground parts are encased in mud and when planted are sunk deep enough so that the two or three lowest nodes of the culm are completely covered. Care must be taken that the newly planted cutting is well watered.

Propagation by cuttings of the rhizome alone is a still more simple process. Lengths of from six to eight inches are planted at a depth of four to six inches in rich loam and watered well during the summer. The cutting should always be from the growth of the preceding year, for these contain

the buds still in a living condition. Shoots from the nodes of these will appear the following spring as in the preceding cases.

Locally, propagation by the second method is more convenient though not any more effective than by the third. Also, there is some advantage in carrying along a leaf-bearing culm inasmuch as the nutrition of the plant will not then be unduly disturbed. For transportation to distances, however, because of their small bulk, the third and fourth varieties of cuttings are found to be more economical. The difference between the third and fourth is that a better start may be had by the former. Since the spread of the bamboo plant primarily depends on the growth of the rhizome, the sooner the new rhizome commences to grow the sooner will the plant become productive. New rhizomes spring from a node of the old rhizome where the base of a culm is attached. Transplanting with a piece of the culm attached, therefore, is of some advantage. Without the culm, as in the fourth method of propagation, sufficient time will be required first to produce a few small culms and then a new rhizome bud will develop. Practically a year is gained by using the third method. Certainly from many points of view, principally because it combines the good points of both the second and fourth, the third commends itself to commercial use, The practice in general then is to make cuttings of whatever kind from the young parts of the plant. Moisture is of prime necessity at all times. Transplanting may be done in the first, second, eighth, ninth and tenth month of the Chinese calendar and when the shoots do come up, great care must be exercised not to jar them or trample on them lest they be injured and cease to grow. In this case a whole year's growth will be lost.

After the shoot has attained its growth, it is pretty sure to survive. It has, however, one enemy against which provision should be made. Wind is very destructive, not directly but through the lashing of neighboring culms. The wood of the new culm is soft and cannot stand continued strain or sudden shock. Consequently, before a heavy typhoon wind the desperate lashing of the hardened whip-like tops of the older culms either breaks off or permanently injures the growing-point or beats down and destroys for further use the young culm. In order to provide for this emergency the custom is to trim the drooping tops so that less surface is left for the wind to catch, and the culm like a shaft rises straight to the cut end. The same thing is done to bamboos which inhabit the mountain sides at higher altitudes. Here snows are frequent during the winter. If the tops were not cut off, the added weight of the snow on the tips would be disastrous. The culms would buckle lower down and even though they lived to harden, they would be useless for anything but fuel. The culm does not break clean off but, owing to the unequal strain due to bending, several longitudinal splits occur, usually in the internode, which suffers the greatest strain and in consequence collapses. Trimming results in a tremendous economic saving, for even though the weak terminal sections, which are useless anyway, are cut off, the lower parts which bear foliaceous

branches will continue to harden and when the time is ripe will be fit for use. There is still one further reason for pruning the tops. In such species of bamboo as are especially productive of edible shoots as Phyllostachys mitis, Riv. (Kiangnan 江南竹), it pays to cut off the top of the culm because this diverts more of the plant energy into sprout production. Accompanied by proper soil treatment, this procedure brings in greater returns, as not only is there as a result a larger number of fleshy sprouts to be had in April and May the regular time for cutting, but the number of winter shoots which though smaller command a higher price will be greater also.

The practices employed in the cultivation and general treatment of bamboo in China, as has been shown, are outgrowths of custom and the experience of generations. They are mostly good, but by scientific study and standardization they could certainly be improved with beneficial results. The experience in India, the Philippine Islands, and Japan shows this. At present in China no specific instruction in bamboo forestry is offered in the schools of Agriculture or Forestry. Even knowledge of the facts is still in a vague and disorganized state. At Canton, investigations are being carried out by Prof. McClure of the Canton Christian College. The Nanking University Forestry School has one graduate student pursuing the study of bamboo solely. The rest of the contributions are chiefly from independent observers or from outside sources. The Chinese Government Bureau of Economic Information has investigated bamboo to a certain extent, but with the tremendous field which this organization has to cover, it is obvious that not much of a comprehensive nature has been done along this particular line. Moreover, any comprehensive survey demands the co-operation of specialists. We repeat that to put the bamboo industry of China on a productive basis proportionately equal to that of other Eastern countries, a special forest technique worked out scientifically needs to be developed and taught along with other subjects like sericulture and animal husbandry.

Chapter III. The Distribution of Bamboo

There are 490 kinds of bamboo in the world, according to an authority who has listed and described them all. So far 60 species have been identified as definitely Chinese. Probably there are still others to be added to the list. The 60 Chinese species are distributed among eight genera, the three largest being *Arundinaria*, *Phyllostachys*, and *Bambusa* comprising 12, 21, and 16 species respectively.

Generally speaking, bamboo does not grow wild north of 35°, *i.e.*, a line drawn from Pingliang, Kansu, east along the Yellow River to Kaifeng, Honan, and thence along the Kiangsu-Shantung border to the sea. It is more frequent toward the south, and especially on the low-lying plains and valleys near the southeast coast. The hill and mountain varieties of bamboo are to be found farther inland on the slopes and foot-hills bordering the tributaries of the Yangtse, the West, the Kiulung, and the Min rivers. The varieties occurring on the higher places are usually dense thickets of scrub, some even growing at an altitude of 13,000 feet. *Phyllostachys pubescens* (*Mao Chu*, 毛竹), our largest bamboo in the lower Yangtse valley, grows best at 2,000 feet altitude. In the larger towns and cities of Shantung and Chihli, bamboo is cultivated in gardens for ornamental purposes only. The bamboo material made into various articles such as brooms, furniture, etc., is shipped entirely from the south. Some varieties are hardy in even more northerly places but are never found wild. They could never succeed on the poorer soil and through the longer freezing seasons of the north.

China Proper is said to occupy about 1,500,000 square miles. This excludes Manchuria, Mongolia, Sinkiang, Thibet, and Kokonor. If we include the Manchurian provinces of Fengtien, Heilungkiang and Kirin, the area totals over 1,890,000 square miles. Those who have been in China a long time and have studied the forest problem at all, know how the timber is fast disappearing. Books have been written, special investigations have been made, talks and lectures have been given on the subject of China's disappearing forests, but to no avail. One of the factors in this disregard may be the prevalence of bamboo. Bamboo can always be had; according to one estimate, about 120,000 square miles are taken up with bamboo forests and isolated groves. We believe this to be a conservative estimate.

Excluding Manchuria, the timber belt follows the great S-like curve made by the mountain ranges beginning east of Poyang Lake with the Nan Shan. It follows south and west along the Fukien-Kiangsi border, turning

west along the Kwangtung-Kiangsi border to Liping, north to Ichang, across the Yangtse, northwest and west along the Tsingling range, then south along the Tibetan frontier across the Szechwan Marches and western Yunnan following the Mekong river. The bamboo belt cannot be said to follow any such definite line for the reason that bamboo is ubiquitous. It occurs on cultivated farms as well as in wildernesses and no cliffs on high mountains. True, it is found mixed with coniferous forests in various places. Wilson reports it mixed with the Silver Fir (*Abies Delavayi*) on thes lopes of Wa-wu Shan, Szechwan. Aug. Henry mentions it as abundant north of Ichang in the coniferous forests. We have seen it ourselves in Chekiang mixed with Cunninghamia, Cryptomeria, and Pinus. Therefore, in a sense, bamboo, especially the mountain varieties, can be said to follow the ranges. But as we have seen, it is not confined to this kind of environment.

To get a fairly accurate idea of the distribution of bamboo three methods have been used. (1) An analysis of literature. (2) The preparation and sending out of questionnaires. (3) Direct questioning and personal observation by investigators. The most fruitful and certainly the surest sources of information culled by the first method are the botanical books which describe the species collected, and mention as well the places from which they come. Such works as E. G. Camus's "*Les Bambusees*", the "*Index Florae Sinensis*", and the "*Plantae Wilsonianae*" are the most reliable. Other books of a more popular and less technical character which are nevertheless just as reliable are Wilson's "*A Naturalist in Western China*" and Shaw's "*Chinese Forest Trees and Timber Supply*". Of a more special nature we may mention Rhodin's "*Notes on the Flora and the Reafforestation Possibilities of the Province of Chekiang*", Aug. Henry's "*Notes on the Economic Batany of China*", and "*The New Atlas and Commercial Gazetteer of China*". The last has commercial and forestry maps on which to a certain extent one may rely. Then, questionnaires have been sent out to places where previous maps and literature indicated nothing. Up to the present all the questionnaires have not yet come back. They were designed with a view to simplicity and quick returns consistent with the information wanted, and so far they have sufficed. The aid of Consuls, customs officials, and missionaries in various parts of China has been invoked. Regarding the last method of obtaining information, personal observation has contributed its quota in the form of reports from agents specially delegated through the kind offices of the Chinese Government Bureau of Economic Information to work on the problem. To this we have added our own experience. We hope that the new distribution map which contains the results of these investigations here summarized will be an improvement on those previously published.

It is best to outline briefly the distribution of bamboo by provinces as follows:—

1. Chihli. In gardens around Peking and Tientsin, and possibly elsewhere. Cultivated only.

2. SHANSI. Shansi-Honan border north of Hwaikingfu, Honan. The northern part is treeless.

3. SHENSI. Cultivated around Sianfu and all along the Wei valley. Also in the Hangchun and Hingan districts. Found in the valley of the Han and along its tributaries from Fo-ping-ting to Ningsia. It is abundant on the Tsingling mountains up to 7,000 feet altitude where it forms dense thickets.

4. KANSU. On the lower slopes of the southern mountain ranges. Information from these regions insufficient.

5. SHANTUNG. In Laichow, Weihsien, Tsinan, Yenchow, Tsaochow and Ichow it is cultivated in gardens. Rocky soil and dry seasons unfavorable to bamboo.

6. HONAN. It is said that bamboo used to grow wild in the north when the climate was less dry. It is reported around Hwaiking. but there is none at Kaifeng or between Kaifeng and Kweiteh. Honan is said to be the most treeless province in China. Kaoliang stalks replace bamboo for fences and various other uses. A recent report direct from Nanyangfu says there is some bamboo in the nearby mountain valleys; also around Kwangchow in the southeast.

7. KIANGSU. Occurs chiefly in the central and southern parts of the province, but is restricted locally to isolated groves owing to the fact that most of the land is given over to the cultivation of rice, cotton, wheat, barley, beans, rape, and vegetables. Cultivated around Sungkiang, Shanghai, Kunshan, Soochow, Wusih, along the Grand Canal to Yangchow, and up the Yangtse to Nanking. A great deal of scrub found on the hills around Soochow and Wusih,

8. ANHWEI. Central to the southwestern portion adjoining Kiangsi. Bamboo is cultivated around Anking and Wuhu districts.

9. HUPEH. Found on the slopes of Shengmu Shan in the northwest and down the Han valley; also on the southern slopes through Chushan, the valley of the Nan Ho and beyond to Nanchang. Another belt extends east along the Yangtse valley from Patung to Nantu, north as far as Singshan (to 3,000 feet and thickets to 8,000 feet), south to Changyang, about Ichang and all through the Fang district up to 9,600 feet altitude. Direct reports from Wuchang say it extends over the adjacent foot-hills.

10. SZECHWAN AND SZECHWAN MARCHES. Found generally throughout the Red Basin, the extreme eastern point being Wushan. Found in abundance especially in the southeastern part around Luchow, down the Yangtse to Chungking, and southward to Nanchuan and the Chin-shan hills. It is reported from Chengtu and west to the Tibetan frontier near Tachienlu up to 13,500 feet

altitude. Also south from Chengtu to Kiatingfu and the environs of Mt. Omei, which with Washan and Wawushan (described by Wilson) are said to be covered with dense growths of bamboo mixed with conifers. Reported around Paoning and Suiting.

11. CHEKIANG. Generally plentiful. Abundant in the following districts: Huchow, Mokanshan, Hangchow and up the Tsien Tang river, Shaohing, Chenghsien, Ningpo, and Haimen; also in the south from Lungchuan to Wenchow.

12. KIANGSI. Found around Kiukiang; from Nankang to Yining; from Nanchang southwest to Yuanchow via Tungshan; in the extreme east around Kwangsinfu and Hokow; Anjen (east of Nanchang) south along the Kiangsi-Fukien border and the valley of the Fu Ho to Ningtu; and finally in the southwest around Kanchow and west to Nananfu through the upper valleys of the Kan Kiang and tributaries.

13. HUNAN. Reported from the Changsha district. The regions from Yiyang to Paoking bordering on the Tzu river are the most productive.

14. KWEICHOW. In the valleys of the south, northeast of Singyifu. Further data lacking.

15. FUKIEN. Very plentiful. Most abundant along the Min and Kiulung rivers; in the north from Shaowu to Yenping, and thence to Foochow with branches to the north via the Siyangki and south via the Shwang ki. In the south the regions southeast of Tingchow centering around Yungting on the Kwangtung border to Pingho, across to Amoy and up the Kiulung river constitute a very productive territory.

16. KWANGTUNG. Occurs everywhere. Chief centers are Wankwaishan in the south; Hongkong, Canton, Macao, and the valleys of West River, the Bamboo river coming down from Pakmashan on the Kwangsi border, and the Pei Kiang or North river coming down from the north. Swatow at the mouth of the Han is another center.

17. KWANGSI. Reported from Wuchow, also from along the Cassia river to Kweilin. Some bamboo obtained from the south from the regions around Nanning.

18. YUNNAN. The only place it has been definitely reported from is Mengtsz and from the mountains in the southeast on cliffs up to 8,000 feet. No further information.

A Map of China showing the Distribution of Bamboo.

The regions in which bamboos grow are shaded. The black circles in the north locate cities where bamboo grows in gardens. The bamboo areas on this map are those about which there are definite reports, no supposition or guess work being employed.

The references on which the following list of species is based are as follows:

(1) **Camus:** *Les Bambusees.* Paul Lechevalier. Paris, 1913.

(2) **Forbes & Hemsley:** *Index Florae Sinensis.* The Linnaean Society.

(3) **Freeman-Mitford, A.B.:** *The Bamboo Garden.* London, 1896.

(4) **Henry, Aug.:** *Notes on the Economic Botany of China.* Shanghai, 1893.

(5) **Wilson:** *Plantae Wilsonianae.*

(6) **Rhodin, C.T.:** *Notes on the Flora and the Reafforestation Possibilities of the Province of Chekiang.* Shanghai, 1924.

A List of the Different Kinds of Bamboo Found in China

1.	Sasa auricoma, Cam.	China (?)
2.	" argenteo-striata, Cam.	"
3.	" aureo-striata, Cam.	"
4.	" palmata, G.C.	Chekiang Mokansan, Hupeh, Ichang.
5.	" Veitchii, Rehd.	Shanghai (cultiv.)
6.	Arundinaria densiflora, R.	Kiangsu hills; Chekiang hills near Huchow, Taihoo Lake.
7.	" dumetosa, R.	West Hupeh, Wen-tsao-shan, Hsing-shan-hsien. Thickets at 8,000 feet.
8.	" Faberi, R.	Szechwan, above Chungking on the Yangtse River.
9.	" flexuosa, Hance	Kwangtung, Danes Island, Whampoa.
10.	" Fargesii, Cam.	Szechwan, Tchen-keou-tin
11.	" Hindsii, M.	Hongkong.
12.	" nitida, Mit.	Hupeh, in the Fang district on cliffs, 6-9,500 feet alt.; Szechwan, mountains in the north, and south of Wushan.
13.	" rigidula, Cam.	Szechwan, Tchen-keou-tin.
14.	" sinica, Hance.	Hongkong, Mt. Victoria and Happy Valley Woods.
15.	" sparsiflora, R.	Hupeh, Hsingshan throughout coniferous woods on mountains, 8-9,500 feet alt.
16.	" Szechuanensis, R.	West Szechwan, thickets nearly 10,000 feet alt.
17.	" Wilsoni, R.	Hupeh, Fang district, scrub on the mountains, 7,700-9,600 ft.
18.	Fargesia spathacea, Franch.	Szechwan, mountains in Tchenkeoutin district.
19.	Phyllostachys Aurea, A&C. Riv.	China.
20.	" bambusoides, Sieb & Zucc.	Kiangsu, Nanking; Fukien, Amoy; Hupeh, Nantu, Ichang.
21.	" congesta, R.	Kiangsu, Wusih, Soochow; Chekiang, Mokansan; Western Hupeh, Patung, Changyang, Ichang.
22.	" Faberi, R.	Chekiang, Ningpo mountains.
23.	" flexuosa, A & C. Riv.	Cold parts of China.
24.	" Henryi, R.	Hupeh, Nantu.
25.	" heteroclada, Oliv.	Kiangsi, Kiukiang; Hupeh, Nantu and mountains to the north; Szechwan, west and Tibetan frontier near Tachienlu, 9,000-13,500 ft. alt.
26.	" montana, R.	Szechwan, Mt. Omei at 3,000 ft.
27.	" nana, R.	Kiangsi, Kiukiang; Hupeh, Nantu, Ichang; Szechwan.
28.	" Nevinii, Hance.	Hupeh, Kwangtung, Danes Island, Whampoa.
29.	" " var. Hupehensis, R.)	Hupeh, Ichang.
30.	" nidularia, M.	Chekiang, Taihu Lake; Kiangsi, Kiukiang; Hupeh, Ichang, Nantu, Changyang to 3,000 ft. alt., Hsing-shan, 400 to 3,000 ft. ravines, sides of streams; Szechwan, Chungking; Kwangtung, Macao.

31.	"	puberula, Mak.	Kangsu, Nanking.
	(nigra var. Henonis, Stapf.)		Hupeh, Changyang, 3,000 ft; Szechwan, Nanchuan, Luchow; Kiangsu, Shanghai (cultiv.)
32.	"	pubescens, Houz. de L.	Chekiang, Hangchow, Mokansan; Kwangtung. To 2,500 ft. alt.
33.	"	quadrangularis, R.	Chekiang, Wenchow, Hanchow; Yunnan. Kiangsu, Shanghai (cultiv.): Szechwan.
	(Bambusa angulata, M.)		
34.	"	Stauntoni, M.	Fukien, Chihli, Peking (cultiv.) Kiangsu.
35.	"	Veitchiana, R.	Hupeh, western.
36.	"	viridi-glaucescens A & C. Riv.	China.
37.	"	violascens, A & C. Riv.	China.
38.	"	Mannii, Gamble.	China.
39.	"	mitis, A & C. Riv.	China.
40.	Bambusa agrestis, M.		Cochin-China.
41.	"	arundinacea, Willd.	China, India, and Ceylon. China, Szechwan.
42.	"	Beecheyana, M.	Szechwan, Kiatingfu, 1,400 ft. Kwangtung, Canton.
43.	"	Blumeana, Schultes.	Cochin-China.
44.	"	breviflora, M.	China. Formosa.
45.	"	Cantori, M.	Hongkong, Lentao.
46.	"	flexuosa, M.	Kwangtung, near Canton; Hainan; Cochin-China.
47.	"	mitis, Poiret.	Cochin-China.
48.	"	nana, Hort.	China.
49.	"	Oldhami,. M.	China. Formosa, Tamsui.
50.	"	stenostachya, Hack.	China. Formosa.
51.	"	Teba, Miqu.	South China.
52.	"	tessellata, Mak.	China.
	(Sasa tesselleta, Mak. et Shib.)		
53.	"	tuldoides, M.	Hongkong, Kwangtung, Canton. Formosa.
54.	"	vulgaris, Schrad.	Chekiang.
55.	"	" , var, striata, Gamble	China.
56.	Dendrocalamus affinis, R.		Szechwan, Mt. Omei.
57.	"	latiflorus, M.	Hongkong, Barracks; Burma. Formosa.
58.	Pseudostachyum polymorphum, M.		Hupeh, Nantu and mountains to the north.
59.	Schizostachyum chinense, R.		Yunnan, Mengtzs. Mountains to the south-east, on cliffs, 8,000 feet alt.
60.	"	dumetorum, M.	Hongkong, Happy Valley. Ravine on Mt. Davis.

Total, 60 species.

Like other plants bamboo may thrive in different environments. Bamboo is found at sea-level and from there up as high as 13,000 feet. We see it thriving on irrigated plains, but we find it also on cliffs high up on mountain sides. We wonder at its luxuriant growth in the loamy soil of the rich valleys and forests, and again at its hardness in thriving on gravelly hill-tops and upper slopes where most of the good soil has been washed away. In the tropics we have a wonderful collection of bamboos, but we also find them in northern latitudes. Some of their hardy relatives are cultivated in

the temperate and even colder regions of China. Collectors have imported and grown them successfully in England, which is considerably farther north than Peking.

There are, however, certain outstanding conditions which may be called the most favorable, and in which the plant grows best. Bamboos are hungry plants and respond to generous treatment. This point has been discussed before in connection with the cultivation of bamboos. In a wild state the conditions may be judged by the character of the bamboos which grow there. If such observations are summarized, it will be found that moisture is perhaps the foremost necessity of the ideal environment. A very good way to observe this fact is to measure every day a growing bamboo shoot, keeping accurate account of the weather conditions at the same time. It will be found that the curve of growth day by day follows closely that of the percentage of moisture in the air. This fact has been corroborated by several independent investigators. Our own observations showed that on rainy days and on cloudy days with a great deal of humidity in the air, the growth was most rapid, while on days which were dry with a hot sun or on which a coldish wind was blowing, growth was very slow, *i.e.* the gain for that day was very little. In mid-summer when the streams dry up we have observed a high mortality among the bamboos inhabiting the upper valleys of mountains. The explanation is that the soil, which is very scarce in these places, (merely what is washed down from above and caught between the rocks and loose stones) is sufficient to maintain plant life only if properly irrigated. When the stream, therefore, dries up under the rays of a hot continuous sun and the stones below become heated, thus accelerating the evaporation of what soil moisture is left, the roots wither and the bamboo dies despite the chance presence even of a trickling remnant in the stream-bed. Occasionally this happens, but normally frequent mountain showers swell temporarily these streams, the plants get a brief soaking along with a bit of fresh soil, and they take a new lease on life. In dry year, however, as it was on the mountains of Chekiang in August, 1924, when there was no relief and the south valley bottoms down to the lower slopes gradually dried up under the pitiless glare of the sun, the bamboo turned yellow, the leaves whitened and dropped off, and many of the canes fell over like stiff dead sticks. In other places, it weathered the drought because the soil was deeper, and therefore better able to retain its moisture, or because of a location which was less exposed. There is still further evidence that moisture is an important factor in the environment of bamboos. They are found most abundantly along the waterways, among the rice paddies, in coastal regions where they can be bathed by sea mists, in the tropical forests and jungles, but never in dry places such as the loess country of northern Shansi, or in rocky soil, as on the hills of Shantung. All this indicates that moisture is the most decisive factor in determining the distribution of bamboo.

An analysis of the conditions in which bamboo grows best in a natural state will show at once that shelter is also of some importance. Protection

on the north and east seems to be of great assistance in bringing about better growth. The reason is obvious. The cold winds are usually from the north and northeast, and where temperature is also an object, protection from cutting winds is an advantage, and in some places a necessity. The young shoots when they come up are extremely tender, and if in the spring when they first appear they are whipped about as they grow taller and battered by the older canes around them, growth will be very much hampered. A southerly exposure is the best. Observation convinces us of this. Some practical illustrations we have seen on the Chekiang hills, especially about Mokanshan. In two separate cases the best growth of *Phyllostachys pubescens* (*Mao chu*, 毛竹) was observed on southwesterly slopes. The breezes from the south are warmer, less violent, and more moist.

The very fact that most of the bamboos occur in the tropics is sufficient to show that, generally speaking, warmth is desirable. Indeed, their demand for moisture is of necessity contingent upon the presence of higher temperatures, since in colder regions the moisture in the soil would freeze and destroy the roots. Conversely, we have shown that extremes of heat are fatal if not mitigated by sufficient moisture. With these factors must be considered soil, a third important constituent of the favorable environment. It is usually the case that in the presence of warmth and moisture, the work of mineralizing decaying leaves and the production of soil in general goes forward at a rapid rate. A loamy or alluvial soil is ideal for bamboos. Some varieties are hardy with respect to climatic conditions, but a closer analysis will reveal the fact that their hardiness arises chiefly out of the rich soil, which has been provided for them to grow in. In nature, such provision does not always occur, in which case the canes will soon die, and eventually the underground stem. A slightly sandy soil is not fatal nor is a clay soil, but the small canes and pale leaves indicate that conditions are not right. From observations in nature, from the experience of farmers, and from the practice of gardeners, we may conclude that the presence of rich alluvial soil such as we have in the Yangtse valley and the frequent occurrence of bamboo of certain kinds are significant of the close relation existing between the two.

Besides moisture, shelter, a southern exposure, warmth, and a rich loamy soil, bamboo is governed somewhat in its distribution by the surrounding flora. Fairchild says that bamboo will not grow in the presence of oak (*lih*, 櫟; *Ch'ing-kang*, 青剛) or chestnut (*Lih*, 栗) trees. Persimmon trees (*shi*, 柿), on the other hand, do not check the production of shoots. This seeming fastidiousness is probably due in part to the effect of root excretions, which in the one case are harmful but in the other neutral. Some may have observed the frequent association of bamboos with conifers. In many places, in Chekiang, in the Fang district of Hupeh, and elsewhere, there are heavy growths of bamboo interspersed with coniferous forests. Certainly from the standpoint of beauty, the dark green

of the latter makes the proper background for the arching plumes of bamboo. It is interesting to think of these two survivals of a past age co-operating, as it were, to resist the onslaught of more recent, rapidly maturing species.

Another factor that may have something to do with the association of bamboos with coniferous trees is the character of their respective root-systems and the latter's influence on space relations in the soil. A spreading root-system near the surface of the ground such as that of *Pterocarya stenoptera* (*Yuan pao foong*, 元寶楓) would naturally interfere more with the growth of bamboo and the production of new shoots than would the deeper roots of such trees as *Cunninghamia* (*Sha sung*, 杉松) and *Cryptomeria* (*Liu sha.* 柳杉), for instance. So far as the tree is concerned, this association is beneficial if the seedling can succeed through the first year. Since bamboo canes grow so rapidly, the danger is that the seedling may become uprooted by an elongating shoot. Because of the conical shape of the shoot, however, an actual collision with the seedling will be avoided. The shoots will push up through the soil past the seedling, crowding it a little, but that will be all, unless the rootlets should happen to get tangled around the point of the shoot as it comes through. But the chance of this happening is very slight. It is not certain even that a seed would germinate in close proximity to a clump-forming bamboo, for example. On the other hand, the shelter and protection from the withering rays of the sun in summer afforded by the leafy plumes of bamboo is a distinct advantage to the seedling, especially at this young stage in its life history. As the years pass, the seedling grows into a sturdy sapling. There is less danger of crowding canes now because the spreading limbs have begun to cast deeper shadows and the roots have begun to crowd and envelop the underground stem of the bamboo. Strangulation of the new buds combined with the reduction of food-making minerals in the vicinity of the sapling is not an impossible explanation of the check to shoot and cane production. The sapling has the advantage of continued growth in size, which the bamboo has not. This favors the success of the tree. When it has grown taller, once more the region around its base will be free, for its roots have penetrated below the level of the bamboo root-system, and the lower limbs will have dropped off through self-pruning. There is one aspect, however, which is not so favorable to the young tree, especially to those intolerant of shade. In his study of the reafforestation possibilities of the province of Chekiang, C. T. Rhodin says that the slopes are singularly unproductive. Though there is plenty of pine and fir, yet at 35 years of age the forest should have carried three times the present amount of wood. This forest is not cut for firewood, so that cannot be the reason. He explains that the mixture of bamboo with pine and fir seems to handicap the pines, which do not thrive in the shade. "The brooms of the bamboos shoot practically everywhere up above the crown-roof and by their constant thrashing of the pine crowns hinder the pines in their struggle for light."

As far as the bamboo is considered, the growth of the forest trees in and about the area which it occupies is a protection. In the first place, these

trees help to stabilize air-currents. In other words, they form windbrakes, thus saving the half-grown tips of the shoots from destruction. Moreover, they have a moderating effect on the temperature of the surrounding regions. Their leaves in the course of their metabolic activities absorb a great deal of the sun's heat. At the same time transpiration goes on. This added moisture thrown out into the air cuts down the evaporation of water from the soil, a very desirable thing for bamboo. Lastly, the roots of trees help to hold the moisture in the soil. During the rain a small portion of the precipitation adheres to the leaves, about a sixth, depending on the amount of leaf surface; about a third constitutes surface run-off; while the remainder sinks into the soil. Of this the humus, like a moist blanket over the soil, holds a part, the roots absorb another part, to be made over into cellulose or transpired, and the remainder drains off underground. However, there is a danger in overcrowding, which would prevent the light from getting to the bamboo. But overcrowding is rare in China, owing to the fact that forest trees of any sort are very rarely left to attain respectable dimensions before they are chopped down for coffin wood or fuel. Moreover, the rapid growth of bamboo must be borne in mind. Nevertheless, there is an economic problem in the competition between these valuable market plants. We need timber trees but we need better bamboo also. There is a call for the adjustment of the relations between these two, a task plainly for the skilled forest technician with a knowledge both of timber trees and bamboo.

Chapter IV. The Properties of Bamboo

The fact that bamboo is so widely used in China and commands so much wealth in trade lends weight to the supposition that its characteristics are suited to manifold uses. A comprehensive glance at the wide range of its uses inspires us to inquire more closely into those qualities which render bamboo so valuable.

There are first of all certain external features which help make bamboo useful. In the handling of it many of the difficulties encountered with other lumber are not met with. None of the complicated machinery necessary to the loading of logs in the timber regions of the United States is needed. Bamboo never becomes so large nor is it ever so heavy as timber logs. In China a simple skidway straight down the hillside to the bank of a stream in the bed of which a stone platform for making rafts has been constructed is all that is needed. No rough bark increases the friction in skidding and no teams of horses are required to pull heavy logs out of the woods to the landing. Though wet bamboo is extremely heavy, it is never unmanageable, and when dry it is very light. This is a virtue which brought the bamboo pole into such universal use in western track athletics to take the place of the wooden pole in the pole vault. In transportation lightness is a characteristic to be thankful for especially in a country like China where carrying is done so much by human labor. In regard to water transportation lightness is not the only, or the chief, virtue. Buoyancy rather is the quality of bamboo poles most helpful in such transportation. This is due to their internal construction. The poles are hollow except for the partition at every joint. Instead of being a simple tube a pole is thus divided off into a series of air-tight chambers; for this reason bamboo poles when they float draw very little water. As a consequence, they are as good as life savers. It is for this reason alone that in valleys and on the plains at the base of the hills the rafts which are made up are capable of being floated out from very small streams to the canals and thence to the markets.

The smooth polished exterior of bamboo poles is in itself a remarkable, almost unnatural, characteristic. No finish applied by human hands is so smooth and hard. The immediate cause is the secretion by the epidermis of wax and silicon. The waxy coating is the basis of the polish, while the silicon compound is responsible for most of the hardness. Some idea of the quantity of silica contained in bamboos may be gathered from the fact

recorded of one species, *Bambusa Tabacaria*, that it will emit sparks when struck with an axe. Though polish and hardness are sufficiently remarkable traits of the epidermis to warrant special mention, they are no more advantageous to the plant than its imperviousness to water. Even parasites find it very difficult to effect an entrance so long as the epidermis is left intact. In time, however, the combined action of moisture, weak mineral acids, mildews, and micro-organisms succeed in forcing an opening in the protective armor of the culm. For a good illustration watch the base of a bamboo fence post. In a year the fibres have rotted through. In the air, however, bamboo poles as they stand in the lumber yards seem able to resist decay for years. This applies more so if the poles are being used constantly as boat poles, clothes line supports, carrying poles, etc. In the bamboo forests pieces of canes have been found with the wood entirely rotted out, leaving only the epidermis as a shell.

The saying that a chain is no stronger than its weakest link might be revised to apply to bamboo. A bamboo pole is no stronger than its weakest joint. It seems peculiar that the only solid parts of the cane should be the weakest, but a moment's examination will serve to convince us of the fact. In the first place, the fibres at the joints are not so compact as they are in the other parts. They are loose and spreading, interspersed with small fibres which as branches of the vertical strands weave in and out at right angles to them and finally pass inward as part of the supporting skeleton of the partition. The results of mechanical tests support our statement and verify our conclusions. Out of fourteen shearing tests carried out by the Whangpoo Conservancy Board on dry specimens of bamboo, six were with straight fibre, while the other eight were with specimens which included a joint each. In the former case the average stress was found to be 1,183 lbs. per square inch; in the latter 1,155 lbs. per square inch. These results in general were corroborated by others. Another investigator found the average shearing stress for specimens without joints to be 2,740 lbs. per square inch and for specimens with joints 2,000 lbs. per square inch. Again, we notice that the specimens with joints average less than those without. The explanation is that the joints are the weakening element. They are less able to withstand shear than the other parts. In young specimens it is even more true because of the fact that the hardening process reaches the fibres of the joint last of all. A young cane when bent over too far will snap off at the joint. Examine the branches and see where they usually break off.

In some cases, however, weakness at the joint may be increased by rot. The scar or ring just below the raised ridge of the joint proper is a favorable place of attack from fungi and bacteria. As a tender shoot the joint is enclosed in a protective sheath-leaf. Later, as each section in order attains its full size, the sheath-leaves fall off, leaving behind a scar which like the leaf-scars on trees becomes thoroughly corked over as a protection against the loss of internal moisture and the invasion of pests. But this does not always take place without accompanying defect, nor can the

chance always be avoided of attacks by boring insects in the wake of which spores and penetrating mycelia find their way into the tissues and eventually the joint.

But, withal, the pole, by reason of the partitions, is stronger than if they were not there at all. They are not massive and their density is only half that of the main part of the cane, but because of their large number the cane is better able to resist certain strains since they are well distributed. The partitions help the canes to maintain their tubular form under bending strains. Because of this fact, together with the fact that it has a high tensile strength, bamboo is said to have a flexural strength similar to that of a fir pole. And if in addition we mention again its lightness and rapid growth, we are speedily brought to the realization of the great utility and value of bamboo.

Since in its mechanical equipment lie the principal virtues of bamboo, let us examine this problem a little more closely. As a preliminary statement it may be said that in mechanical construction the sky-scrapers of New York cannot compare with bamboo structures.

To ascertain more completely the true nature of the mechanical properties of bamboo, physical experiments have been undertaken. The tests referred to above were conducted at the instigation of the Whangpoo Conservancy Board to discover the possibilities of bamboo as a material for reinforcing concrete. In all 220 tests were carried out for bending, shearing, elasticity, tension, and compression respectively. The mean result of 150 bending tests was 13,300 lbs. The ultimate flexural stress varied between 11,000 and 14,000 lbs. per sq. in., depending on the way the loads were applied. The collapse of the bamboo was always sudden, the material first splitting into pieces parallel to the longitudinal axis. None of the fibres were torn. Collapse was evidently caused by the shearing force. The average stress in the shearing tests was 1,183 lbs. per sq. in. for dry specimens and 1,033 lbs. per sq. in. for green. The modulus of elasticity was found to be 1,660,000 lbs. per sq. in., about the same as that of pine. The ultimate tensile stress of bamboo was worked out in the same way as it is for steel reinforced concrete. Concrete beams reinforced with bamboo were tested for bending and the value of the tensile stress calculated by means of the appropriate formulae. The concrete cracked, due to the very large deflection, so that in the calculations the tensile stress of the concrete was entirely neglected. The ultimate tensile stress of bamboo was found to be 14,000 lbs. per sq. in. In this connection it may be stated that the cables used to tow the junks up the Yangtse gorges are made of bamboo strips taken from the outer 1/8" and plaited together. It has been estimated that the tension on the ropes averages 10,000 lbs. per sq. in., but very often it is more than doubled. From the compression tests the ultimate stress was found to be 5,500 lbs. per sq. in.

Compared with other woods we may quote the following values for bamboo from the report by Messrs. H. F. Meyer and B. Ekelund to the Engineering Society of China:—

"If the value of the compressive stress of the kind of wood in question is called 100, we will find that the value of tension, deflection, and shearing are as follows:—

	Tension	Deflection	Shearing
Beech	400	200	29
Oak	270	177	26
Pine	210	160	22
Fir	270	163	23
Bamboo	255	218	8

"The ultimate stress for different kinds of wood in sq. in.:—

	Beech	Oak	Pine	Fir	Bamboo
Ultimate compressive stress	4,500	4,900	3,500	3,900	5,500
Ultimate tension stress	19,000	13,700	10,500	11,200	14,000
Ultimate bending stress	9,400	8,400	5,900	6,600	13,000
Ultimate shearing stress	1,200	1,050	560	700	450

"As regards compression and bending, bamboo is slightly superior to all other kinds of wood here mentioned. The bending problem in the case of bamboo is different from that of the other kinds of wood because of the peculiar form of the section of a bamboo stem.

"As to tension the strength given in the table above is exceeded by that of the beech; however, in order to do justice to the bamboo, it should be remarked that the outer layer of the stem such as used in the native ropes on the upper Yangtse has a strength of at least 25,000 lbs. per sq. in.

"In compression as well as in tension bamboo excels most other kinds of wood. Its weakness toward shear limits its use in modern European structures but the same weakness renders the material suitable for the primitive needs of the Chinese farmer."

Because of its superior qualities, bamboo has been considered promising material for the reinforcement of concrete. But its elasticity is a great disadvantage. A test beam, bamboo reinforced, when placed horizontally on its supports (one at each end) cracked before any load had been applied, but did not completely break down until it had carried a comparatively heavy load. This is a tribute to its high tensile strength. The Chinese Government Railways have used bamboo to reinforce concrete friction piles which are used as foundation for railway bridges. The chief object was to strengthen the pile during handling and driving operations. The Whangpoo Conservancy Board has used concrete plates reinforced with bamboo for vertical bunding below water. It was reported that in 1918, 1/4" square split bamboos were used as part of the reinforcement for a two-inch concrete wall designed as a protection for the ten-inch cork insulation of a cold storage for the International Export Co. at Nanking. It is recommended when using bamboo as reinforcement material to split it into small square or lath form, soaking it well before imbedding.

Two factors, however, have yet to be investigated before a final judgment can be passed on the suitability of bamboo as reinforcement material, Tests have been planned but not yet carried out by the Whangpoo Conservancy Board on the question of the rate of decay of the imbedded bamboo strips. Also, the problem of shrinkage is serious, but so far no information on this subject is available. The latter comes to our attention particularly in consideration of the bond between concrete and bamboo. Ordinarily, satisfaction has been expressed on this question. The projections at the joints when the pole is split into strips offers enough corrugation to give mechanical bond. But up to date no pull-out tests have been made to find out just how firmly the concrete adheres to the bamboo strip. It is interesting to note that after certain reported bending tests the reinforcing strips of bamboo were taken out of the failing beams and tensile tests made. The result did not show the diminished strength expected. On the other hand, the recoil seemed to be complete and perfect. Another interesting fact was the dryness of the above strips; moreover, there were no signs of decay or deterioration. The strips had been imbedded only four months,—too short a time to determine the efficacy of concrete in preserving the bamboo.

If bamboo proves to be a practicable reinforcement material generally it will cut down the cost of construction considerably. The cost of bamboo reinforcement in Shanghai is about 20 per cent of that of a corresponding iron reinforcement. This shows quite a substantial reduction. But according to present information it can be recommended only where its strength during construction matters. Independent investigators have brought out other physical characteristics of bamboo. Among its other properties might be mentioned its specific gravity. Of split bamboo the specific gravity was found to be 0.862. But it varies in different regions of the cross section. The specific gravity of the outer silicious layer, which is one-sixteenth of an inch thick, of the bamboo is in old dry canes 50 per cent greater than that of the inner or main part. The average for the coefficient of friction was found to be .279. Tests were carried out to ascertain if possible the coefficient of expansion. These were apparently not successful. It was thought, however, that expansion due to heat within the temperature limits to which concrete is ordinarily subjected is negligible.

A histological examination of a thin cross section of bamboo will show that it is extremely porous at regular intervals toward the inner layers. This is due to the extreme width of the water vessels of the vascular strands. The tissues surrounding the vascular tubes are very different. They are composed of fibres with thick walls and narrow cavities packed together very tightly. These predominate toward the periphery. In young shoots which have been allowed to dry out, the intervascular tissues have not yet hardened so that they dry out, break down and disappear, thus isolating the fibro-vascular bundles. This alters the space relations within the cane and accounts for the shrinkage and distortion of green culms which have been cut while very young. A study of the distribution and arrangement of the

vascular bundles shows that they are smaller toward the outer edge of the cross section and much more numerous. At the same time the size of the water vessels is very much smaller. These facts explain the greater density and hardness of the outer "1/16" of a bamboo cane. All this compact fibrous tissue, protected on the outside by the hard silicious epidermis together with the peripheral layer, not only forms a protective barrier around the inner and less dense region occupied by the larger non-mechanical vascular strands, but is also responsible for its stiffness and resistance to compression.

Lastly, not only from practical experience but also from a view of the longitudinal section of a cane, we see that the grain of bamboo is very straight. From the tangential section the fibres may be seen to run up and down throughout the whole length of the pole in a straight line. From the radial section, however, there is a slight crook at every joint which variles with the position of the particular fibre toward the inner or the outer edge. At any rate, from the practical standpoint, the strands run straight from toe to bottom. This is of real benefit to the farmer who can go out to his litph grove with a dull cleaver and with a few well-directed whacks at the ritgt angle fell a pole in no time at all and split it throughout its entire length before an ordinary person could saw through a two-inch limb. As we leanred from a study of the pole in relation to shear, the partitions offer on difficulties. These partitions, which are about the consistency of compressed pith, though adequately supported by a network of cross fibres, are easily knocked out. A single blow with a dull tool is usually sufficient. A good idea of this aspect of bamboo may be had by watching a Chinese laborer at work building one of the ubiquitous bamboo fences.

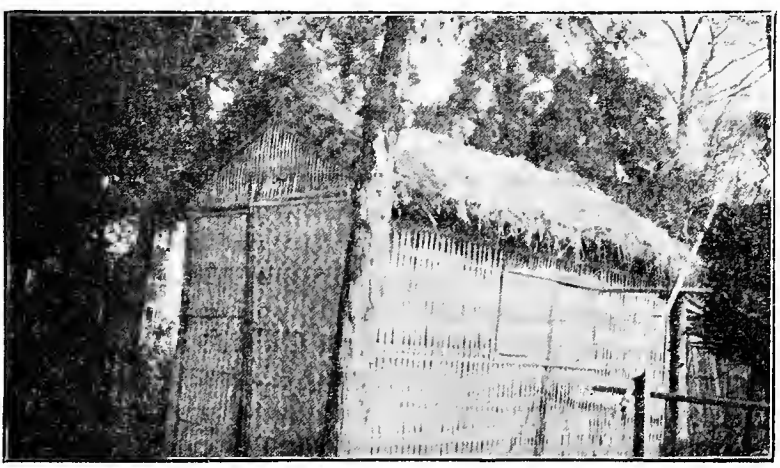
There are external factors that combine to make bamboo a plant of great economic importance. Up to the present we have emphasized the internal characteristics. Now let us see what influence its general distribution and habits have on its usefulness. In the first place, as we see from the map, bamboo occurs everywhere south of the Yellow River with the exception of Shantung, most of Honan, and the mountains of the west and southwest at altitudes over 13,000 feet. Its common occurrence enhances its usefulness. Then, also, it grows thickly. Unlike the woods with which most of us are familiar, bamboo forests are very dense, the culms coming up so close together at times that a man can scarcely push his way between them. There are two distinct types of bamboos which are characterized by their habit of growth. There are the clump-forming kinds and the more loosely separated types. In the latter case the culms occur singly and separate from each other, while in the former the culms come up close together, sometimes touching. There is a third type which is intermediate. One plant consists of many small clumps connected by an underground stem. It is more like the second of the two major types except that instead of single separated culms, there are four or five culms close together in the place of each. In any case, therefore, a comparatively small plot of ground can be very productive, proportionately much more

than the land occupied by Western woods. For instance, a plot of ground 45 feet by 15 feet had 111 culms on it according to our investigation, or one culm to every six square feet of land. According to an estimate made by the Whangpoo Conservancy Board, from a dense plantation eight years old about 400 culms per *mow* can be cut yearly (1 *mow*=7,260 sq. ft.). At this rate a comparatively small area can produce a great quantity of poles. We must be reminded of the fact, however, that only one out of every four poles is fit to cut, since the practice is to allow four years for hardening. In estimating, therefore, the stand can be taken as about four times the yearly production. If the yearly cutting per *mow* is to be 400 culms, the stand per *mow* must be close to 1,600.

The third and last characteristic is its rapid rate of growth. This has been discussed in a previous chapter but we mention it here in this connection to correlate and bring out especially those external factors that help make bamboo economically such a valuable plant. What more could be desired in a useful plant than that only a small bit of land need be used for it to grow on, that a dense growth can be successfully maintained on it without much trouble, and that the full growth of the most used parts may sometimes be attained in less than seven weeks.

Chapter V—Uses of Bamboo

If bamboo and all things made of bamboo were suddenly transposed out of China, the whole social order would be disrupted and the people would become entirely disorganized or reduced to a state of savagery and miserable dependence. There is no doubt that bamboo is the great provider of China. No other plant has ever been put to such general use, or has been so closely associated with a people in so many of the intimate details of their daily life. It is of such common occurrence that very few people take any notice of it at all. It is taken for granted like so many other things that daily strike the eye.

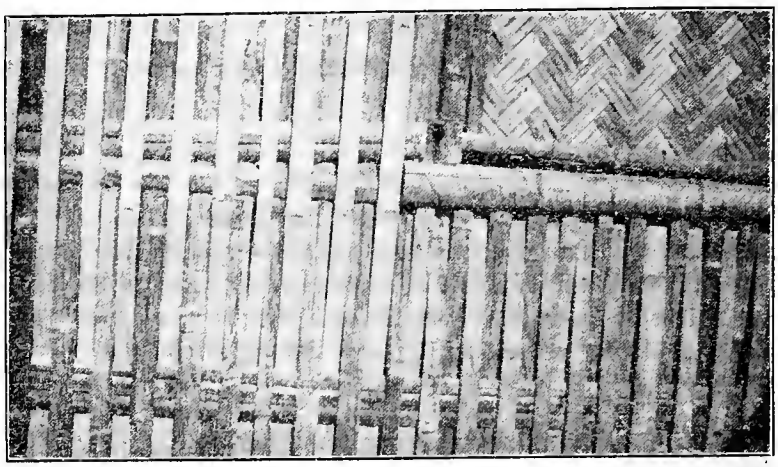


Garage built of Bamboo.

To realize how fully bamboo answers the many simple needs of the Chinese farmer we have only to read Dr. B. C. Henry's concise summary:

"The multiform uses of this wonderful plant are amazing. Houses may be built of it, the heavier trees standing as pillars, and making good rafters; the split canes in broad sheets woven with wattles form the sides, or cut into halves make the floors; the door of the same material, fastened with bamboo thongs, and locked with a peculiar bolt of the same wood; while the roof is composed of bamboo-thatch, which is perfectly impervious. The furniture in the form of stools, chairs, tables, couches, pillow, is all of bamboo, while cups, water-pails, ladles to dip out the rice, and wrappings for cakes of various kinds are of the same material. The fuel for the clay furnace, and the young sprouts stewing in the pot, are from the same root. The mats to sleep upon, the lattice that forms the windows, the ladder to ascend to the loft, lamps to light the room, the lanterns to hang outside the door are all of bamboo."

Bamboo poles and laths furnish the framework and main part of a great many different kinds of buildings, from simple shelters, sheds, pavilions, temporary living quarters, and contractors offices to garages, city watch-towers, theatres, summer houses, and permanent homes. The annual flower thows in Shanghai are held under great exhibition sheds built very cleverly so look like public buildings. They are built in a week; they are taken



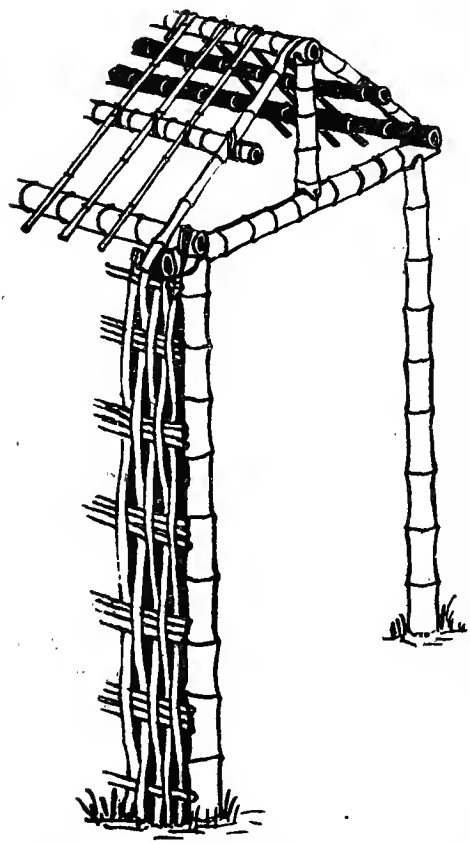
Detail of Bamboo Garage.

down in less than a week. Not a single nail is used. The poles are tied with bamboo strips taken from the outer 1/8". The temporary dressing rooms for the numerous tennis courts on the Shanghai Race Course constitute a veritable colony of bamboo houses, all built more or less on the same plan with mat roof and peaked corners. Even the grandstands around the base-ball field used to be made of bamboo materials. In putting up modern structures of brick, steel, and concrete, bamboo is of inestimable value as scaffolding. The whole face of a new building is hidden behind a meshwork of bamboo poles and woven lath until completed. The usual farmer's house in the Yangtse valley and south is built with a simple gable roof thatched with rice straw. The framework is of bamboo poles; the sides of woven bamboo lath plastered with mud and whitewashed. The roof beams are bamboo poles interspersed with smaller bamboo canes on which are tied split bamboo mats. These are made to overlap like the scales of a fish or like shingles on the roof of a foreign house, and form the foundation for the thatch. The door is also of woven bamboo lath swung on wire hinges, sometimes bamboo thongs.

A shed 10 by 15 by 10 ft. with thatched roof and double door at one end (see figure) suitable for a small temporary garage costs $32.00. It can be put up in four days with no plan to begin with other than the estimated number of bamboo poles from which to get the framework supports, the woven lath sides, and the close woven door panelling. A bundle of about 48 small bamboo canes and the requisite number of bundles of thatch straw may be included with the raw materials on hand. The whole job can be done by

three men and an apprentice. In Yunnan, Milne and Cochrane say, the Shans construct houses of bamboos which are soaked for weeks to harden them and prevent the attacks of boring insects. For an ordinary house, they go on to say, sixty to seventy large bamboos and a hundred small stems are required, costing from £6 to £10.

With buildings may be considered bridges. When not made of stone the bridges that span the canals are often made of bamboo. The most efficient type of bamboo bridge, however, is the suspension bridge. The most famous one of this kind in China is the An-lan Chiao over the Min River on the road between Kuan Hsien and Monkong Ting in Szechwan Province. It is best described in the words of Mr. Ernest Henry Wilson:



Details of Construction of Garage, door end.

"This most remarkable structure is about 250 yards long, 9 feet wide, built entirely of bamboo cables resting on seven supports fixed equidistant in the bed of the stream, the central one only being of stone. The floor of the bridge rests across ten bamboo cables, each 21 inches in circumference, made of bamboo, split and twisted together. Five similar cables on each side form the 'rails'. The cables are fastened to huge capstans, embedded in masonry, which are revolved by means of spars and keep the cables taut. The floor of the bridge is of planking held down by bamboo rope on either side. Lateral strands of bamboo keep the various cables in place, and wooden pegs driven through poles of hard wood assist in keeping the floor of the bridge in position. Not a single nail or piece of iron is used in the whole structure. Every year the cables supporting the floor of the bridge are replaced by new ones, they themselves replacing the rails. This bridge is very picturesque in appearance, and a most ingenious engineering feat."

The only kinds of fences used in China are bamboo fences. Of these there is a tremendous variety both in size and weave. The fence posts are sections of bamboo poles, one being planted every five feet which is half of a *chang*, the ten-foot unit of length. By counting posts it is possible to tell how long the fence is. The main part of the fence is wired to the posts, which holds it firmly and prevents it from falling.

The two commonest types of fences are the *hsi yen*, 希眼 and the *lao hu*, (老虎). Both of them are made of bamboo lath woven on long bamboo strips, but they differ in their weave. In the former the laths are about

three inches apart and criss-cross obliquely, making a diamond-shaped mesh; in the other type of fence the laths are vertical and run close together, leaving no interstices. A four-foot fence of the former type costs Mex. $1.00 per *chang*. A fence of the latter type uses much more lath and hence is more expensive. An eight-foot fence like this costs Mex. $2.70 per *chang*. In all cases the cost depends on the kind and the height. Extra fence posts are $0.25 a piece. Various improvements and trimmings can be had for a little addition to the price. The cheapest fences have no top rail, the tops of the laths ending free. By splitting a bamboo pole and wiring it so that the free ends are enclosed in the concave inner surface, the fence acquires a top rail and finished look. In order to aid in the resistance to decay, the fence may also be tarred. This is applied with a rag bunched up and tied to the end of a long thin bamboo pole. The usual price is $0.50 per *chang*. These are the prices which the foreigner has to pay. It is difficult sometimes to find out what the Chinese pays. The farmer buys a few poles for $0.30 a piece if he has none growing on his place, and builds his own fence, but as a rule fences are very few in the country. What there are, are live shrubs with interlaced branches.

A third kind of fence, the *li chu pa* (籬竹笆), is commonly seen about Shanghai enclosing gardens and properties instead of the usual cement-faced brick walls. It is a finer-looking fence than either of the other two. Instead of being made with split bamboo, whole canes of the *li chu* (俚竹), a small variety of bamboo, are used. The fence is about eight feet high, some are less, and the ends of the canes in the finished fences are bent downward to give the top a scalloped appearance. The main body of the fence is too heavy for bamboo fence posts, so wooden posts are used. In pattern the fence looks something like the *hsien ngan po*, but there are no open spaces. Instead of one lath and then a space, five or six canes are bunched together with no spaces between, being woven in and out and constituting the body of the fence. Tarring improves both the looks and the durability of this type of fence. Per *chang* it costs $6.40. Bamboo latticed arbors of bamboo are especially decorative in the garden with vines trailing over them. Most of the fences on the farms of the Yangtse valley are made of the branches of live shrubs interwoven as they stand and bound down with straw The new shoots of the following year are interwoven again and bound or trimmed back.

The chief value of bamboo fences lies in the fact that they are all-inclusive. Anything, even small chickens, put in an enclosure surrounded by a bamboo fence is really enclosed. This of course applies more particularly to the second type of fence. Again, bamboo fences are very light but very tough, and they are inexpensive. There can be no crawling between the bars of a bamboo fence. Furthermore, it is very difficult to scale them—they are so shaky and springy. They seem so unstable, but in reality a bamboo fence in good condition is superior to anything except the woven wire stock and poultry fences used in the United States. It may not be heavy

enough to withstand a violent attack by a water buffalo, for the reason that the posts might give way or the wire fastenings might break, or again because the long horizontal strips that form the warp of the fence might pull out, yet the fibres would never tear. After a year or two of exposure to alternate wetting and drying, however, the fibres become more brittle, and break under strain more readily. The first signs of deterioration may be seen in the posts. These begin to rot around the soil line, often break off merely from the weight of the fence, and thereafter until replaced just hang on, a dead weight. A sagging fence indicates the need of new fence posts In a typhoon a bamboo fence is in great danger because it is so light and presents a solid front to the wind like a sail. Since typhoons occur infrequently and at certain times of the year only, the chances are in favor of the fence.

The saying that a chain is no stronger than its weakest link might be revised to apply to bamboo. A bamboo pole is no stronger than its weakest joint. It seems peculiar that the only solid parts of the cane should be the weakest, but a moment's examination will serve to convince us of the fact. In the first place the fibres at the joints are not so compact as they are in the other parts. They are loose and spreading, interspersed with small fibres which as branches of the vertical strands weave in and out at right angles to them and finally pass inward as part of the supporting skeleton of the partition. The results of mechanical tests support our statement and verify our conclusions. Out of fourteen shearing tests carried out by the Whangpoo Conservancy Board on dry specimens of bamboo, six were with straight fibre, while the other eight were with specimens which included a joint each. In the former case the average stress was found to be 1,183 lbs. per square inch; in the latter 1,155 lbs. per square inch. These results in general were corroborated by others. Another investigator found the average shearing stress for specimens without joints to be 2,740 lbs. per square inch and for specimens with joints 2,000 lbs. per square inch. Again, we notice that the specimens with joints average less than those without. The explanation is that the joints are the weakening element. They are less able to withstand shear than the other parts. In young specimens it is even more true because of the fact that the hardening process reaches the fibres of the joint last of all. A young cane when bent over too far will snap off at the joint. Examine the branches and see where they usually break off.

In some cases, however, weakness at the joint may be increased by rot. The scar, or ring just below the raised ridge of the joint proper is a favorable place of attack from fungi and bacteria. As a tender shoot the joint is enclosed in a protective sheath-leaf. Later, as each section in order attains its full size, the sheath-leaves fall off, leaving behind a scar which like the leaf-scars on trees become thoroughly corked over as a protection against the loss of internal moisture and the invasion of pests. But this does not always take place without accompanying defect, nor can the chance always be avoided of attacks by boring insects in the wake of which spores

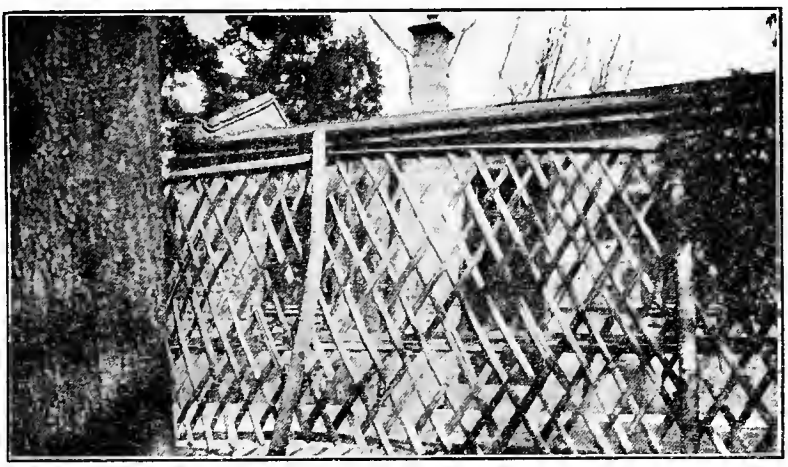
and penetrating mycelia find their way into the tissues and eventually the joint.

But, withal, the pole, by reason of the partitions, is stronger than if they were not there at all. They are not massive and their density is only half that of the main part of the cane, but because of their large number the cane is better able to resist certain strains since they are well distributed. The partitions help the canes to maintain their tubular form under bending strains. Because of this fact, together with the fact that it has a high tensile strength, bamboo is said to have a flexural strength similar to that of a fir pole. And if in addition we mention again its lightness and rapid growth, we are speedily brought to the realization of the great utility and value of bamboo.

There are many uses for bamboo poles. Scaffolding has already been mentioned. This is put up very rapidly, only unsplit poles tied together with green bamboo thongs being used. For this work usually the *mao chu* (毛竹 *Phyllostachys pubescens*) is used. These large sized poles retail in Shanghai at from $0.80 to $1.00 a piece according to size. There is a medium-sized kind known as *mao ching* (毛巾), which is used for boat poles and other things. Both the above kinds supply material for fences. Building contractors, who are by far the largest users of bamboo fences, employ men specially to split poles and build fences. Moreover, these men are expected to be able to estimate closely the number of unsplit poles needed for a fence around any given area. Poles are extensively used for masts on small boats. Towed boats always have the tow-line fastened to the top of a bamboo mast because of its springiness. It gives with the step of the pullers, yet at the same time exerts an almost constant pull on the boat. Where the canal banks are built up, or otherwise crowded, the tow-line is dispensed with; also, when the boat is too heavily loaded, the junkmen take to the pole, three or four stamping along each side of the boat, chanting in unison with the movement of the shoulders of the polemen. Besides masts and boat poles, these larger varieties of bamboos are very frequently seen in the form of flag poles, tent poles, and props of various kinds. In Indo-China bamboo is used for telegraph poles.

Shorter lengths of these same big poles are used for carrying heavy loads. The part used is that near the base, since the wood is thicker there. In the cities one often hears the familiar antiphonal 'heigh-ho'ing, indicating that a heavy load is being moved off somewhere. And the heavier the load the louder and more agonized the chant. The load is suspended by ropes from the middle, and the ends of the carrying pole rest on the shoulders of two men. In the case of heavier loads the ends of the primary pole may constitute the center loads of two secondary poles, the weight then being distributed between four men instead of two. The chanting helps the men keep time, a very important factor in transporting the load easily. They get into the swing and can take advantage of the recoil of the pole to make their steps forward. In this way the load is always heaviest when the two men,

taking the first case, have both feet on the ground and lightest when they are taking a step. A split pole about five feet long, tapered except for a small knob at both ends, serves as a carrying apparatus for one man alone. A small load such as a bucket of water or a small hod of bricks may be suspended from each end and the whole balanced on the shoulder of the coolie. He uses the same principle in carrying his load as the two men cited above. Smaller varieties of bamboo supply the world's demand for fishing poles. Others have their tops lopped off and are run through the sleeves of washed jackets or other garments and stuck out of windows as drying racks. This is an especially convenient method for boat people as well as villagers who live over their shops.



Hsi yen pa, (希 眼 笆) Bamboo fence (1)

Bamboo furniture, first made in Tientsin, is now fashioned by small shops in many parts of the country, and scores of dealers are to be found in Shanghai. The bending and twisting necessary to the making of some of the articles is accomplished by holding the pieces over a flame and burning them slightly. The yellow and black effects are obtained by treatment with sulphuric acid and baking. A square table big enough for mahjongg playing retails in Shanghai for about $6.00, a chair for $2.50, and a tea table to match $2.00. The workmen who make bamboo furniture in Shanghai come mostly from Tientsin, where they learn their trade. They earn about $10.00 a month and receive food and sometimes living quarters. It is a privilege of workmen in this trade that their employers shall not demand any given number of pieces from them during the month.

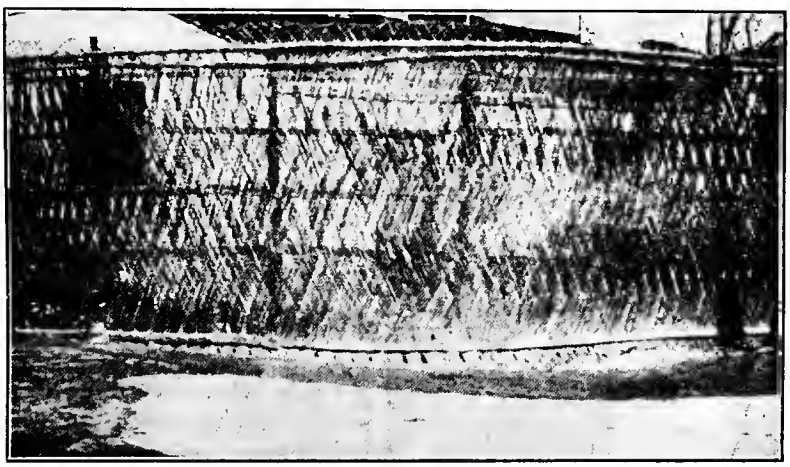
Besides the pieces of furniture mentioned, bookcases, desks, couches, stools, boxes, and sedan-chairs are made of bamboo, and are popular not only with the Chinese but with the foreigners as well. A carved section of bamboo in which one partition has been left as a bottom makes a very attractive flower vase. Teapots and jugs of bamboo are not uncommon. Even oil lamps have been made of bamboo, though they are almost things of the past now. A few still remain in use in the interior. Bamboo is also em-

ployed in making many desk furnishings. The handles of Chinese pens have always been made of a special variety of small bamboo. Also, pen-holders and paper containers, some of them beautifully and elaborately carved. Formerly, historical records were written on bamboo tablets strung together like a fan. Records of this description dug up in A D. 281, after having been buried for 600 years, were found to contain the history of Tsin from 784 B. C. and incidentally, it is alleged,that of China for 1500 years before that date. The framework for holding Chinese copy books when being used to practise Chinese characters is also made of this material. A great many decorative schemes are carried out with bamboo fret-work and lattices.

Lao hu pa, (老 虎 笆) Bamboo fence (2)

The variety and uses of bamboo boxes are numberless. A few of the chief and best known are the money-box, the incense-box, the paint-box, and the food-box. Every food hawker and small shop-keeper has his money-box. It consists of a section of large bamboo with a partition in the top and in the bottom, making it look like an elongated drum. In the top partition asmall slit is cut to slip the money through. Food-boxes are made in sets. There are usually three in a set, one fitted on top of the other, the handle enclosing all three being fastened to the bottom one. Bamboo baskets are also of many varieties and uses. They vary in size from the smallest toy basket to great receptacles for grain that will hold a ton or more. Cheap little bamboo baskets are provided by food shops for customers to carry away their small orders of prepared food. These baskets come in pairs, are like round shallow dishes in shape, and fit together over the parcel in about the same way as the shells of a fresh-water mussel. Waste basket, shopping baskets, and sewing baskets display very fine workmanship. These are made from the outside "green" of the bamboo and are beavtifully designed. Baskets for carrying pigs, big and little, for ducks, geese, chickens, all in different shapes, bird-cages, cricket traps, snares to catch partridges and quail, and hampers are all made of bamboo. Sieves and trays for trying grain and sseds exhibit a variety of sizes, some of the latter being six feet in diameter, and these also are made of bamboo.

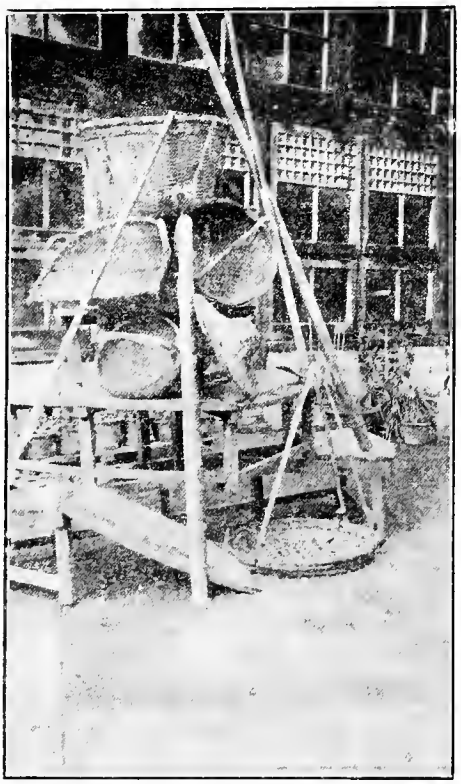
Closely woven bamboo strips in the form of panels suitably mounted in bamboo frames and hinged together make very serviceable screens. Very narrow thin strips from the outside of bamboo when properly strung together make very fine sun blinds. More efficient in the way of sun protection, however, is a kind of mat awning. Very thin strips of bamboo are woven into mats about 6' × 3' and tied on to bamboo pole frames put up over the tops of the windows. In the summer time many office buildings and residences in Shanghai have these bamboo awnings put up on the side of the buildings which get the afternoon sun. This variety of sun screen has the advantage of allowing plenty of air to circulate in and out of the open windows while affording all necessary shade.



Li Chu Pa, (籬 竹 笆) Bamboo fence (3)

In the garden as on the farm bamboo finds a great number of uses. In the first place the handles of a great many of the digging tools are of bamboo. Pruning hooks and saws are mounted on long bamboo poles, and also small baskets with claws for plucking fruit. But most useful of all are the ladders. These are sometimes over thirty feet in length. The two side poles are firmly wired together to prevent the bamboo rungs from falling out. Bamboo ladders are wonderfully light and easy to handle, and they are safe until cracks begin to appear. Even then if the internodes are wired immediately before the wood has a chance to rot, they will last a very long time before they need be discarded. Trowels, spades, shovels. "dust-pans", buckets, tubs, foundations for brushes, and brooms, are familiar bamboo-made articles. Regarding brooms, it may be mentioned here that they are made from the branches and heads or tops of bamboo. Near the tip of the culm, the diameter of the cane diminishes beyond the point of major usefulness, so it is chopped off, together with the branches, and sold to make brooms. This material finds a considerable trade in the outports, and large shipments are made from Shanghai and southern ports to Tientsin, Chefoo, and other northern cities where bamboo brooms are made. When they have any spare time, as on rainy days, the farmers chop the branches

into definite lengths according to fineness, grade them, and then tie up the material into bundles for export.

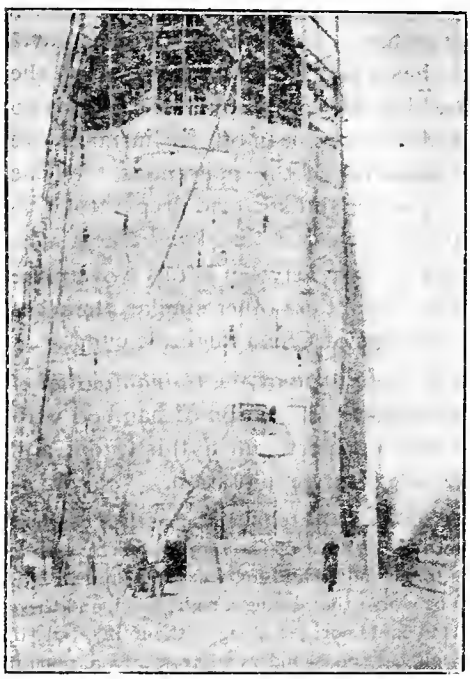


Various bamboo articles used in the garden. (Note the hat in the center of the pile)

Other bamboo articles seen on the farm chiefly are yokes for cattle, certain parts of primitive farm machinery, and rain-hats. Both sun-hats and rain-hats are like inverted open-work trays of narrow bamboo strips except that in the case of rain hats they are reinforced with oil paper to make them impervious to water. Furthermore, they are fitted with a frame for the farmer's head. Some of these hats are very broad and are like a head umbrella. Water wheels and the cups with which water is raised to the rice fields are made of bamboo. For sowing *kao-liang*, millet, etc. up north a peculiar apparatus is used called a *tien hu lu*, 點葫蘆, a large gourd through which a bamboo is passed. This bamboo is slit to hold the seeds stored in the gourd. As the sower walks behind the plough he taps out the seed which has collected at the lower end of the bamboo with a stick. For threshing beans a kind of flail called a *ch'ien* is used. The bean stalks are spread out on hard clay threshing floors and beaten. The portion of the flail used to beat out the beans is made of four or five narrow strips of bamboo bound together by cowhide thongs. This is then tied tightly on to the free end of a cylindrical wooden roda bout four iuches long, and provided with a knob at one end to keep it from slipping through the bent end of the bamboo handle. In harvesting rice a hand scythe is used. It is cut about an inch above the ground, a handful at a time. If there has been much rain and the field is flooded, the harvested rice is hung on a bamboo frame to dry. In threshing, a bamboo frame may also be used against which bundles of rice are beaten, the grain falling through to the other side.

The Chinese fisherman uses bamboo as material for his various implements just as much as the farmer does. Small boats fitted out with ropes, rigging, oarlocks, masts, and sail stays of bamboo, or rafts of bamboo poles, carry him out to suitable waters. His net, dredge, and floats of bamboo offer him one method of catching his fish, while various kinds of basket traps offer him other methods. Shrimps, crabs, and other fish are caught by basket. In the time of the Chin dynasty the people of Ch'ien Tang made a *hung* 箵,

or bamboo dam, in which they caught a million fish a year. In consequence it was called "million-worker dam", *wan chiang hung*, 萬匠潩. In the Ming period a fence of plaited bamboo was built in ponds used for rearing fish. This was called *yii*, 籞. The most ingenious fishing baskets in this period was the *meng sou*, 艋艘. It was made of small plaited bamboos. The cover was of woven bamboo splints to which hairy or bristling bamboos were fixed. The basket gradually decreased in size from the mouth to the junction with the hairy bamboo (leaves ?) to allow of the ingress of the fish, but not their egress.



A building in Shanghai under construction is cloaked, scaffold and all, with a veil of woven strips of bamboo of the *lao hu* type.

Among the hundreds of uses of bamboo are the flute and the fife made from the more perfect sections of small canes. These are cut into short lengths which are bored, tuned and wound at the joints with silk thread. This finished article may be purchased retail for 30 or 40 cents. Short sections of larger diameter serve as the frame of a fiddle head. Pipe organs have been made with bamboo poles and they seem to have attained the purpose at least temporarily, i e. as long as the pipes last. In the category of tubular things made from bamboo are many other familiar articles. Bamboo pipe line have been used successfully for transporting water supply. All that is needed is a long iron rod or a thin bamboo pole to jam out thepartitions. Besides water pipes, bamboo canes have been used for drains and rain spouts. A split bamboo pole with the partitions knocked out serves to conduct the overflow from higher rice paddies across a country path to another on the other side on the next lower level. Also, they are ingeniously fixed so as to catch water from the edges of the sluice that feeds the water wheel of a primitive flour mill and carry it to the axle supports for the purpose of reducing the friction. As long as the water comes through the sluice the axle of the wheel is automatically lubricated. A plunger can be fitted into a straight section of bamboo and a type of pump made. Bamboo tubes are used to raise brine from salt pits along the sea shore. Small tubes are employed at air blowers to stir up a charcoal fire under the plastered iron bowl which in China is dignified by the name of stove. The latter may be seen being briskly worked by a coolie in front of nearly ever restaurant in any village. Formerly, in the silk business tubes of

large bamboos, *t'ung tzu mien*, 筒子綿, were used as frames on which to spread floss silk. All sorts of bamboo splints and frames are used in the silk industry.

Turning to the cotton industry we find that in the Sung dynasty the ***hsiao kung***, 小弓, or small bow for rendering cotton fine and even was made of bamboo. It was one foot four inches in length. A bow string was set upon it and twanged to set up vibrations which would spread the staple of the raw cotton. The *t'an kung* (彈弓) was a larger bow, also of bamboo, about four feet in length, and its upper part was somewhat longer than the lower and stronger part. It was strung with cowgut cord covered with string and was used also to bow cotton. It disclosed the hard parts and loosened the tight ones. Bamboo has played a prominent part in the life of more than one industry, if one had but the opportunity and time to go through the list carefully. In the production of bean oil, for instance, we find bamboo strips intimately linked with several of the operations. In one stage, after the beans have been twice ground and steamed preparatory to pressing out the oil, the meal is tamped into shallow disc-like baskets with grass bottoms. These grass blades are caught between hoops woven like tub hoops out of 10-15 strips of bamboo, Countless other similar instances of the participation of bamboo in the industries of China might be cited.

Dr. Wallace Crawford, in the April, 1926, issue of the *China Journal of Sciences and Arts* goes very fully into the intimate connection of bamboo with the salt industry in Szechwan. His record is so pertinent to this study, and so detailed, that it is interesting to make an extensive quotation.

"Possibly there is no more indispensable article or material in China than bamboo, One missionary who had a knack for such work made a list of the uses to which bamboo could be put. The list was not finished with four hundred and forty separate uses. If it were uprooted from the soil of China, it would be worse than losing a right hand, and there are those who venture to say that the sons of Han could not get along without it. Indeed, so many and varied are its uses around a salt well, that one wonders what would happen if it were suddenly cut off from use. It is the first thing used, for does not the geomancer use bamboo tickets from which to choose when he is trying to decide the location of the new well? And does not the mechanic use a bamboo rule when he first begins to measure the land upon which the well is to be dug? And bamboo makes the stem for the joss sticks which are burned by the priest as he performs his rites when the digging of the well is begun.

"As the well is dug and the derrick is raised, bamboo ropes are used to haul up the logs for the derrick frame; bamboo ropes are used to splice the logs together; wedged tighter by the bamboo wedges. The drum over which the cable is run into the well is bound with bamboo.

"The edging for the wheel which carries the cable into the well is bamboo, while the band that is first put into the well to carry the drill is of bamboo, as is the cable which is later used to carry the brine pipe.

"The conveyer of the brine from the well is a bamboo pipe, fastened to the bamboo cable by hemp. The cable which brings up the brine is twisted bamboo, its manufacture, an industry by itself, carried on some two days' journey from here. The cables are carried in by men. The break which is used on the windlass that winds the cable is of split bamboo, and it runs on strips of bamboo which are lashed by bamboo rope to the wooden windlass. The water buffalo is harnessed with bamboo to the windlass to draw the cable

out of the well, while the driver "persuades" the awkward beast with a bamboo whip. The rope with which he is tied by the nose is of smaller bamboo, and his stable is divided into stalls made of old bamboo cable. The sides of the buffalo barn are made of old bamboo rope twisted about the upright posts. The well coolie wends his way home by the light of an old bamboo cable taper.

"The brine runs to the boiling pans through bamboo pipes. The brine pipes are supported by bamboo pieces split finely so that they may be wrapped around the brine pipes, thus preventing their splitting in the hot sun. Old bamboo cable lashes them to the trestle work when they have to be suspended. Bamboo hoops support the great brine vats as they hold the brine preparatory to its being run into the boiling pans. Split bamboo, supported by old bamboo cable, serves to run the brine from the vats to the pans.

"Bamboo matting is made to separate the boiling rooms, while bamboo baskets make splendid beds for the attendants on the boiling pans. Woven bamboo makes skimmers for the refuse on the top of the boiling pans, and the finished product is carried in bamboo baskets and crates. As a delicacy the coolie enjoys bamboo sprouts as he watches the boiling of the salt, often boiled with bamboo fire wood.

"The coolie carries his load of salt to market with a bamboo carrying pole, and his tally is recorded with a bamboo stick. His sun hat is made of bamboo, finely woven, to keep out the rain, while the mat upon which the pedlar spreads his wares is of bamboo.

"The perquisite of the labourers about the well is the bamboo when it is impossible to use it further in the industry, and this they either sell or take home to help them repair the home or to boil rice.

"The expert boiler, watching the pans, blissfully smokes a bamboo pipe, while his wife not so far away, sews shoes, the soles of which are made of bamboo leaves, the darkness brightened by the light of a vegetable oil lamp made of bamboo. He dips the brine from one pan to another with the aid of a bamboo dipper and strains the refuse through a bamboo sieve.

"Bamboo guy ropes hold the mighty derrick secure when the great gales blow, and the wheel at the dizzy height at the top of the derrick is trussed with bamboo.

"The subject of the uses of bamboo is not exhausted, as there are many others to which it is daily put. But the reader will readily see that if bamboo were taken from the market here in Tzeliutsing, it would parazely the salt industry."

Medicine even is not free of bamboo connections. The famous medicine *Tabashir*, prescribed generally by a Buddhist priest, is guaranteed to cure any and all ailments. In certain bamboos there is found in the cavities between the partitions a substance consisting of silica with a little lime and vegetable matter, or sometimes of silica and potash in the proportion of about 70 per cent silica and 30 per cent potash. It is said to be a concretion due to a diseased condition of the nodes. The opalescent beauty of *Tabashir* is regarded by the faithful as only equalled by its medicinal value. Sometimes the green outer surface of the young bamboo is scraped off, boiled with water, and used later in combination with other medicines or alone as a cooling drink for fever. The green buds of the leaves are employed in the same way and for the same purpose. Of not exactly a medicinal nature is the secretion of the sheath leaves of a certain bamboo. It is said that in the epidermis or in the hairs of the epidermis there is a poisonous secretion which is extremely irritating to the throat and nose, and causes itching which brings on a bad skin infection. This has been known to the Chinese for a long time, for the poison was formerly used in criminal cases. A drink was

prepared into which a lot of these hairs were introduced. Death followed, but not before much agony had been suffered. Cattle are not bedded down with the young sheath leaves of this particular kind of bamboo, nor is it planted in the vicinity of wells.

One of the chief uses of bamboo, however, is to provide material for the making of paper, whether the finest writing material or the coarsest wrapping paper. Not only is there a tremendous trade in the paper itself but in the crude pulp as well. Mr. E. H. Wilson from his studies of Chinese flora and products gives us the best account of the native method of manufacturing paper.

> "Several species are employed for this purpose, one of the commonest being *Phyllostachys heteroclada*. This bamboo is abundant in central and western China, especially in alluvial areas near streams up to 4,000 feet altitude. It grows 12 to 18 feet tall, with fairly slender dark green culms; commonly it forms extensive groves. The stems are cut into lengths, made into bundles, and immersed in concrete pits, being weighted down and kept under water by heavy stones. After three months they are removed, opened up, and thoroughly washed. Next they are restacked in layers, each layer being well sprinkled with lime and water, holding potash salts in solution. After two months they are well rotted. The fibrous mass is then washed to remove the lime, steamed for fifteen days, when it is removed thoroughly washed, and again placed in concrete tanks. The mass is next reduced to a fine pulp with wooden rakes, and is then ready for conversion into paper. A quantity of the pulp is put into troughs with cold water, and mucilage prepared from the roots of *Hibiscus Abelmoschus*. An oblong bamboo frame, the size of the desired sheet of paper, having a fine mesh, is held at the two ends by a workman and drawn down endways and diagonally into the liquid contents, which are kept constantly stirred in the trough. It is then gently raised to the surface, and the film which has collected on the top is deposited as a sheet of moist paper when the frame is turned over. After the surplus water has drained away from the mass of moist sheets of paper the whole is submitted to pressure. It is then dried either in kilns or in the sun, according to quality, the sun-dried being the inferior. Since much water is necessary in the process of paper-making the mills are always erected alongside streams."

Most of the paper made in China is manufactured from bamboos of Kiangsi, Szechwan, Fukien, and Chekiang provinces. In Szechwan province, which is the original paper manufacturing district of the country, the best quality papers are produced. Here the kinds of paper known in trade as *lien shih* (連史), *chwan lien* (川連), and *mao pien* (毛邊), are manufactured, also water-proof papers (油紙) for wrapping purposes. The *lien shih* (連史) and *mao pien* (毛邊) are writing papers. These latter with the *pai kwan* (白關) for wrapping purposes and *mao tai* (毛太), *kin chwan* (京川), and *hwang piao* (黃表) are produced in Kiangsi. The making of paper pulp from bamboo is a household industry in Hunan and Kiangsi. Every third year shows the greatest output because it is at that time that the bamboo is cut. This paper is inferior to Hangchow and Shaohingfu paper. The Tingchow and Tsianglo districts in Fukien are the chief producing places of bamboo-made paper. *Ting kung* (汀貢), *ting pien* (汀邊), and *tsiang lo* (將樂) are well known among paper merchants. In Chekiang province varieties of what are known as *yuan ssu* (元書), *king fang* (金方), *piao sing* (表薘),

and *kao nan* (高南) are produced. Besides these, *hang tsien* (杭阡) for sacrificial purposes and paper for supporting tinfoil are produced from bamboo. Hunan produces a paper of a coarser kind. Most of this goes into fire-crackers, playing cards, wall paper, umbrellas, and papiers rouge. The latter is much affected by Chinese women. Though *Phyllostachys heteroclada* is the bamboo most commonly used for making paper, from the Batung and Changyang districts of Hupeh come other kinds which may be used for the same purpose, chiefly, *Phyllostachys nidularia* and *Phyllostachys congesta*. The former goes under the name of *twei chu*.

Finally, in connection with the material uses of bamboo we come to its familiar appearance in the markets and on our tables as food. Bamboo shoots are a delicacy very popular with both Chinese and foreigners. They are sold in three forms, fresh, dried, and pickled. According to one investigator, the yield ought to be 40 lb. of shoots yearly per *mow*. The earliest or "winter" shoots are the best and of course the most expensive. The later ones picked in April and May are much larger and inclined to be more fibrous. A minimum of fibre is very desirable, since the shoots are then more tender. The farmers feel along the ground with their bare feet and when their toes come across the point of a shoot a small mound of earth is piled over the place not only to mark it but to keep it under cover as long as possible. This is the same kind of treatment accorded asparagus to keep it white. If the bamboo shoot is exposed too soon, it turns green immediately, and that means that fibre development will go forward at a rapid rate. Very often, instead of piling earth over the young shoot, the farmers cover it with a wooden bucket to keep it in the dark. After they are cut, the greatest danger is the loss of water. If they are to be transported a long way, they are packed in baskets in mud and disinterred upon arrival at the markets, the cut ends recut, and the whole sprinkled with water. An analysis shows that they are 90% water. Of the solid remainder 3.2% is protein, 0.2% fat, and 6.2% carbohydrate. An investigation of the vitamine content reveals the presence of a slight amount of vitamine B.

One way of drying bamboo shoots is to strip off the sheathing leaves, leaving only the brittle succulent part. These are boiled with water, then removed and suspended from rafters in a closed chamber, where they are dried over steady burning fires. When thoroughly dry they are packed in bales and carried to the cities, where they are esteemed a great delicacy. Another way is to leave them on the sheathing leaves after splitting, and after boiling to press them flat and dry them. On the slopes of Wa wu-shan near Yachou Fu in Szechuan, Wilson tells us, the collection and preparation of dried bamboo shoots for culinary purposes is a very important industry. But this industry is not by any means confined to this region alone. Most places where bamboo grows at all support a local industry in bamboo shoots. In the country around Chengtu the raw shoots used to sell for only 6 cash per 16-oz. catty, but in the city the prepared shoots sell for Tls. 9 per 100 catties of 20-oz. each, or 9 cents a catty. In Shanghai raw shoots retail

to foreigners at 20 to 30 cents a catty, depending upon the season. (1 catty $=1\frac{1}{3}$ lb.).

The industry is now on the increase because of the introduction of canning. Ningpo and Amoy are the chief canning centres. The figures have been repeated elsewhere, but they are given here again to emphasize the growing importance of bamboo shoots. Exports of bamboo shoots from Foochow to Amoy mostly for canning purposes were estimated at 80,000 catties for the spring of 1924. The current price then was $2.50 per 100 catties. The shoot as well as being a food may, like the culm, house a god under certain conditions. In the valleys among the Chekiang hills between the rice fields one often passes small shrines in which instead of the accustomed idol one sees a dried bamboo shoot. On examination this shoot reveals very unusual characteristics. The most noticeable are the oblique joints which give a zig-zag effect. It has been found that occasionally in a grove of *Phyllostachys pubescens* (*Mao Chu*, 毛竹), which is very common in this region, a shoot comes up with this freak characteristic. The Chinese are quick to discover it and because of its strangeness they think it possessed of preternatural powers.

Out of the cult of ancestor-worship have arisen many superstitions, some of them responsible for the practice of adopting children. Besides true adoption by childless parents, there exists a kind of spurious adoption founded entirely on the superstition that it is possible to cheat the malignant spirits which connive at the illness and death of children. If parents are too poor to bring up their children, especially the sons, the child may be commended at the instigation of a fortune-teller to the care of a tree. The spirit of the tree henceforth becomes its patron. Because it is regarded as a prince among trees, the bamboo is preferred before all others for this kind of adoption. On this account the child, because he has become the ward of such an influential spirit, may have a better chance in life.

Before 221 A. D. carriages, 笨, pens, and barrows were made of bamboo. Sedan-chairs and the carrying poles are still made of bamboo in some parts of China. In some parts of Shantung the people travel by mule litter, the bows that go over the backs of the mules are made of bamboo. Though bamboo is used extensively in the northern provinces, bamboo is not native and therefore must be shipped from the south. Another 'bamboo' method of travel is by raft. To keep the hollow ends of the poles out of water, the better to keep intact the air-tight chambers, the ends are heated and turned up. This is done more particularly to rafts regularly employed as ferries. Bamboo pole-carrying rafts sometimes come from very great distances and usually very slowly. Because they are so long, several men are needed to pole them. Consequently, shelters are built on the rafts for them. Those living on board are responsible until the raft is brought safely to its destination.

There are many miscellaneous uses of bamboo which might be referred to in passing, such as chopsticks, graters, walking sticks, umbrella frames,

foot-rules, probes, pins, castanets, backs of mahjongg tiles, combs, cigarette holders, and fans. Fine combs, graters, and sieves of bamboo are made in Laichow, Shantung, while mahjongg tiles are made in great quantities in Soochow and Shanghai. Hangchow is famous for its fans. The familiar folding fan was not the original fan of China. The fans were first round. According to a certain authority, in the beginning of the Yuan dynasty, the Commissioner of the "South East Barbarians" used a *chu t'ou* 聚頭, and people laughed at him. Then, in the beginning of the reign of Yung Lo (1403-1425), the Ming Emperor, the Koreans sent a quantity of folding fans as tribute. One version states that at first only servants and runners and people of the lower classes used them because they were convenient when serving others. Another states that the Emperor was so pleased with them that he issued orders to the Imperial Works office to imitate them. The were then distributed to the ministers, bestowed as rewards, and given as gifts. Shortly the whole empire was using them, and round fans were discarded.

Among the kinds of walking sticks, that made from the square bamboo (***Phyllostachys quadrangularis***) is especially prized. It was originally made in Yunnan, originally as staves. It gradually made its way north. Chang Ch'ien in 128 B. C. knew about the square bamboo staves in Szechwan; he also found that the people there carried on a considerable trade in staves with the people of Bactria. This kind of bamboo is said also to occur in Shantung, where it is likewise made into walking sticks.

Into the military profession and the religious life of China, bamboo has also found its way. Fine spears and arrows as well as bows and shields used to be made of bamboo; so are torches, conical military hats, criminal beaters, and splints for binding up wounded limbs. The magicians have their tokens and divining rods of bamboo, and the priests their lotteries. The latter are bamboo sticks with numbers which correspond to prophetic poems printed on separate sheets of paper bearing the same number, or cryptic double-edged messages from the gods. The joss sticks seen in such abundance in the temples giving up their fragrance to the idols are slivers of bamboo.

In commerce, the checks, tags and tallies used by the coolie stevedores to keep count of the number of loads carried are made of bamboo. The tallies are long narrow bamboo splints which are usually kept in a rack by a man at the gate, and passed out one by one as each coolie goes in.

Bamboo shavings are used to caulk boats and for stuffing pillows and mattresses. Even cloth for garments has been made of bamboo. Thirty or forty years ago summer garments of bamboo material were popular, but the increased cost of labour has now brought this vogue to an end. It took too much time to make them.

Various articles are also made from the leaves. Rain-coats worn in the south by the countrymen are made of leaves sewn together. Again, in sealing up jars of *Ju Fu* a Chinese food made from beans, leaves are

used. A cloth is first laid over the mouth of a jar containing the preparation. Some bamboo leaves are placed on top, and together they are bound around the neck of the jar with a cord. Finally, sticky clay mixed with the flowers of a reed is put on the mouth and neck and allowed to harden, thus sealing the jar. The preparation cannot be opened within four months, otherwise, the stuff will spoil. This same system is used to seal jars of *Chiang Yu*. The broad leaves of varieties like *Sasa palmata* or *S. tesselleta* are used for wrapping together small parcels of food, Sewn together they are used in packing tea. The coarse leathery sheath leaves of the *Mao chu*, 毛竹, (*Phyllostochys pubescens*) are used in the country around Hangchow and vicinity to make soles for shoes. The sheath leaves enclosing the shoots of the larger bamboos are very broad and one of these tough bracts does adequately for one shoe.

Bamboo has figured most prominently in the art of China. It is one of the four favorite plants and is spoken of as one of the "three friends of winter". Some of the finest paintings have had bamboo as a subject. No landscape is complete which does not include a few gracefully arching plumes of bamboo. Many precepts are derived from bamboo, and its symbolism reaches deep into the life and customs of the people. Even after death a sprig is carried in the van of the funeral procession.

Undoubtedly the best place to get a comprehensive glance at the magnitude and ramifications of the bamboo industry is Shanghai in May. The leased property and roads around the Bubbling Well Temple then become a seething ocean of tents, pavilions, and temporary shelters for vendors of bamboo ware. It is the annual bamboo fair and a sight worth seeing.

List of Articles and Uses of Bamboo.

English Name	Chinese Name	English Name	Chinese Name
Arrows	箭	Brushes	刷帚
Awnings	篷	Buckets	竹桶
Baby's pushcart	小兒坐車	Cable	纜
Barrow	手車	Carriages	笨
Baskets, food	稻籮, 篾籃	Cages, bird	鳥籠
shopping	菜籃	Castenets	響板
sewing	針線籃	Chairs household	竹椅
poultry	鷄鴨籃	sedan	竹轎
waste	廢物簍	Checks	籌
toy	玩具籃	Chopsticks	竹筷
Beaters, criminal	竹板 (刑具)	Cigarette holders	香烟咀
Beds		Clothes rack	竹衣架
Blinds, window	窗簾	Combs	梳篦
Bolts		Cooking vessels	廚房用具
Books, covers		Couches	竹榻
Bookcases	書架	Cow-bells	
Bottles	竹筒	Cups, drinking	茶杯
Boxes, food	食物箱	on water wheels	
cigarette	香烟盒	Curtains	竹簾
clothes	衣箱	Dam, fishing	漁壩, 筏
incense	香匣	Desk	竹桌

money 錢筒
paint 油漆盒
Bows, military 弓
cotton 小弓, 彈弓
for mule litters
Bridges 竹橋
Brooms 掃帚
Li Chu Pa 籬竹笆
Fifes 竹笛
Fishnet 漁網骨
Flails 連枷
Floats for fishing 浮子 (釣魚用)
Flower pots 花盆
Flooring 竹地板
Flutes 竹笛
Foot rules 尺
Forms for bean meal in oil press
Frames, house 竹柱竹椽之類
holding copy books 帖架
plants 花架
procession figures
Korean headdress
lantern 燈籠罩
silk worm 蠶架
threshing
umbrella and fan 傘扇骨篾
weaving 織機架
Fret-work 格子細工
Fruit picker 採菓物
Fuel 柴
Garments, summer 夏衣
Gate springs
Girdles 腰帶
Grain (seed)
Graters 銼刀
God (freak shoot) 竹羅漢
Hairpins 髮簪
Hampers 籐錡
Handles, implement 器具柄
Hoe 鋤頭柄
digging fork 叉柄
polo mallet
spade 鏟刀柄
umbrella 傘柄
rake 耙柄
Hats, rain 箬
sun 遮陽帽
military 軍帽
Hedges 籬笆
Hinges, thongs 竹鉸鏈
Hoops, bucket 桶箍
tub 盆箍
Houses, shacks 竹棚
pavilions 竹亭
Divining rod
Dredge, fishing 撈魚器
Dust "pan" 箕
Fans 扇子
Fences,
Hsi Yen Pa 希眼笆
Lao Hu Pa 老虎笆
playing card 紙牌
sacrificial 冥鏹
stencil for mimeograph 蠟紙
rouge covered for face
Parts, crude machinery
Pens 筆
Pen-holders 筆桿竹
Pins 針
Pillows, summer 竹枕
Pipes, drain 陰溝管
gas
opium 烟槍
organ
stems
tobacco 烟桿竹
Water 水管
Posts, fence
Poles, carrying 竹扁擔
clothes 竹衣桿
boat 竹篙
fishing 釣桿
flag 旗桿
tent 帳桿
telegraph 電桿
vaulting 跳篙
Poison, leaf hairs
Probes 竹探針
Props, clothes line 衣撐
tree limb 樹撐
Pulp 紙之原料
Rain coats (leaves) 簑衣
Rain spouts (roof drains)
Rafts 竹筏
Rattle, watchman's 竹梆子
Rope, and string 繩索
Sail stays 桅桿
Sandals 草鞋
Shavings, caulk boats
stuff pillows
,, mattresses
Scaffolding 棚架
Scoops 水勺
Screens 竹幕
Shield 藤牌
Shoes 鞋
Shoots for eating 筍子
Shovels 鏟
Sieves 篩箕

homes	竹房	Splints	
exhibition shed	竹棚攤	Spades	鍬
Jugs	竹屏	Spears	鎗
Knives	竹刀	Spoons	匙
Ladders	竹梯	Stools	竹櫈
Ladles	竹杓	Sticks, joss	香棒
Lamps, oil	油燈	walking	手杖
Laths	條板	Tables	竹枱
Lattices	格子工物	Tablets, paper holders	
Lotteries	竹籤	records	
Lumber, raw poles		Tags	簽條
Manikins for the tailor	縫工用模型	Tallies	籌碼
Mahjongg tiles	麻雀牌骨	Tokens	
Manure, dry	乾肥料	Torches	火把
liquid	濕肥料	Thatch	茅草
Masts	竹桿	Toys	玩物
Mats	席 篾簟	Traps, cricket	蟋蟀罩
Medicine	藥品	crab	蟹籬
Oarlocks	槳架	fish	魚籪, 艇艘
Ornaments	裝飾物	Shrimp	蝦籠
Paper, writing	寫字用紙	Trays, carrying	竹盤
wrapping	包裹用紙	drying	盤篚
water-proof	油紙	Teapots	竹壺
firecracker	花炮紙	Tea caddies	茶箱
Tubes, blowing fuel	吹火管	Whetstones	磨刀具
raising brine		Wrappers for articles (leaves)	
Tubs	盆	Wardrobes and cupboards	
Vases	瓶	Yokes for cattle	牛軛
Violin heads			

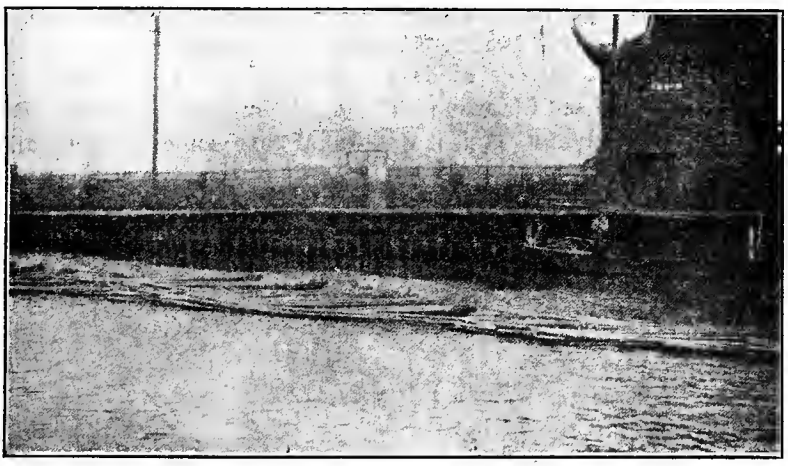
Total: 208.

Terms used in Native Customs

Bamboos, large (one kind)	毛 竹	Bamboo Husks (sheath leaves)	箨 葉
Bamboos, small	爪 竹	Bamboo leaves	箬 葉
Bamboos, very small	鞭桿竹	Bamboo split	竹 篾
Bamboos old	老 竹	Bambooware, miscellaneous	雜竹器

Chapter VI. The Trade in Bamboo

It is obvious that in a discussion of the trade in bamboo, the question of transportation must be considered. As was stated in the chapter on distribution, bamboo for the most part follows the streams. The streams, therefore, offer the easiest egress from producing regions. By their very structure the cut poles are suited for shallow stream transportation. Since roads in the Western sense are very few, and railways fewer, by necessity if not from preference most of the transportation is by water.

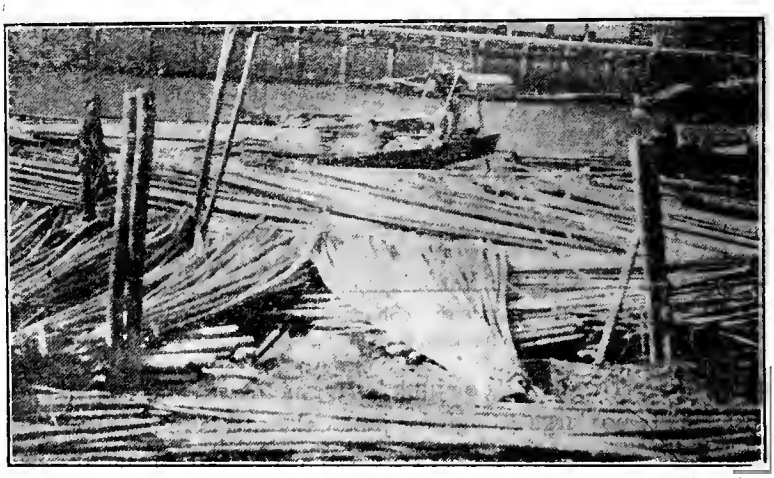


Bamboo raft on its way to Shanghai *via* Soochow Creek.
The bamboo is *Mao chu* 毛竹

Bamboo is carried by raft or junk. But as the streams near the cutting places are usually not large enough for junks, the raft is the method generally followed. This also applies in the case of short distances on canals and rivers. If allowed to soak in the water too long, the culms deteriorate, and in some cases mildew. This lowers their quality and their money value accordingly. So, when carried to distant points, best quality bamboo is carried by junk. Junking bamboo to market is a distinct trade, and some boatmen handle nothing else. The junk owners accept all responsibility for delivering the cargo safely at destination, even to the extent of paying transit taxes. Freight is usually paid according to the number of pieces, and in the case of bundles where the shorts taken from tree tops are shipped, charges are made according to agreement, depending on the size of bundles, etc.

Using Shanghai as an illustration, the organization of the s businesis something like this: the wholesale dealers all have resident agents in producing centers, especially at Hangchow and Huchow. Here the poles are collected from small cutters and piled on a junk until a load is made up, or tied up into bundles and made into rafts. These serpentine rafts, sometimes 100 yards long, are interesting features of the water traffic as they glide along to the cities. The bamboo raft, incidentally, is sometimes used in certain parts of China as a ferry or as a means of transporting passengers. In the province of Szechwan bamboo rafts about 70 feet long are employed to carry passengers from Suifu to Kiatingfu. The front ends of the poles are turned up and platforms are built on the rafts upon which the passengers must stay with their belongings, as the rafts under them are usually awash.

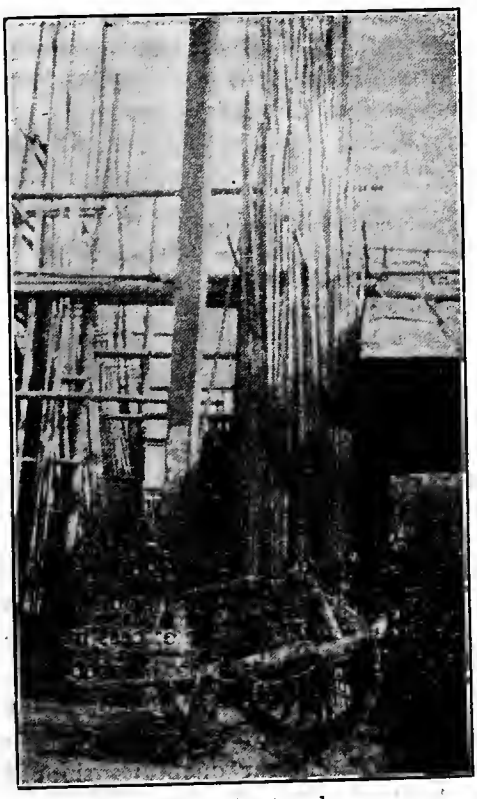
When the poles arrive in Shanghai, they are taken to the yards of the dealers who grade them and pile them in cones, the big ends on the ground. The unit of sale is the *ti*, or bundle. The number of poles in a *ti* varies according to size. There may be fifteen of the largest size, thirty of the medium size, or fifty of the smallest size, in a *ti*. So that in buying a bundle the purchaser gets approximately the same amount of wood in any case. The quoted price per *ti* is $ 10.00 irrespective of contents. Large poles sell for $70.00 a hundred, smaller kinds per hundred are $30.00, and bamboo heads for brooms, etc. sell for around Tls. 70 per hundred bundles. Buying by weight was formerly done, but it was found that some farmers allowed



Landing at a yard in Zau Kia tu, a section of Shanghai.

their poles to soak in the canals to increase the weight. Hence, this method is not now popular. In Shanghai there are many small hongs that retail bamboo. Most of the trade, however, is done through seven big wholesale dealers, four of whom are in Nantao, a Chinese section of the city. It is estimated that each one of these dealers does a yearly business of more than $300,000; that means together a business of over two million dollars in raw bamboo alone. And Shanghai, it must be remembered, is only one of many large cities doing such a business.

The following is a picture of the industry in the Nanking district. There are five kinds of bamboo produced in Nanking which bear Chinese trade names, *Tan chu* (淡竹), *Tsu chu* (紫竹), *Kwang chu* (廣竹), *Ya chu* (牙竹), and *Chao chu* (早竹) respectively. They all grow on the plains. The chief producing centers in the Nanking district are Shun-hua-chen (淳化鎮) a village south of the city, and San-pai-low (三牌樓), a section of the city itself. The economic and commercial value of the different varieties ranks in the order mentioned above except that *Chao chu* should come third. About 500 *mow* of land in the district produce *Tan chu*. (1 *mow* = 1/6 English acre). This bamboo is consumed in the local basket industry. The present market price of *Tan chu* is 39 catties for a dollar, while a basket sells at from 100 to 800 cash (10 to 80 coppers). *Tsu chu* is only produced in the southern suburbs on less than 100 *mow* of land. It is used in making bamboo furniture, which sells at from $2.00 to $10.00 a piece. As the local supply is inadequate, large quantities are imported from Anhwei. Each cane, of about one inch in diameter, sells at about ten cents. *Chao chu* is very brittle, and is cultivated mainly for its shoots, one variety of which, known as *Chao-sun* (早筍), is ready for the market in the first or second month of the lunar calendar, while another, called *Hang-keng-sun* (行根筍), is marketed from that time on to the mid-Autumn Festival. Both are used as food, and are very much in demand by the restaurants. The market price varies greatly, but at present is about 10 or 20 cents a catty. The producing area covers some 200 *mow*. The producing area for *Kwang chu* is about the same for *Chao chu*. It is chiefly used as substitute for clothes lines by washerwomen. Each picul sells at about 270 coppers and contains 20 or 30 stems. *Ya chu* is a fine variety which is used for garden decoration. It is of no use commercially. The shoots are edible and are marketed in the fourth month of the lunar calendar, but they are not very popular.



A bamboo yard

In Foochow one of the commercially used bamboos is a large species called *Ma chu* (麻竹). Manufacturers making use of this variety are mostly located at Nantai (南台). They number over 60 and employ more than 200 laborers. The bamboo is largely made into baskets for bam-

boo shoots, as an extra cover on tea chests when these are shipped to the interior, and for packing lacquer or wooden ware. It is also used to make sheds and fences. The diameter of this kind of bamboo is about two and a half inches. Smaller bamboos are used in making furniture, bamboo screens, umbrella handles, clothes lines, etc. There are over a hundred manufacturers at Cheng-tai (城台), employing over 300 laborers. Strips of a "small bamboo" are made into fruit baskets, and some of them are used to plait into ropes for towing boats, etc.

According to one business man, a manufacturer of paper in China, $60,000,000 worth of paper is made every year from bamboo. Though the paper industry is one of the chief native businesses in which bamboo plays an important part, it is certainly not the only one. Reverting again to the subject of bamboo rafts, we might call attention to the figures for the producing districts, in addition to the figures above cited for the trade in bamboo poles in Shanghai. From the Chuchow district of Chekiang a thousand rafts are sent down every year to Wenchow by sea representing together about 600,000 dollars' worth of bamboo. And this is only one point of destination. It would take only ten such producing areas to put the value of the material exported from these centers at $ 6,000,000. As far as we are able to tell at present, there are at least seventeen producing centers, distributed as follows:

(1). Hwaiking in northern Honan
(2). Sian-fu and the Wei valley in Shensi
(3). Ningsia and Hingan „ „
(4). Ichang and the Yangtse valley in Hupeh
(5). The Han valley, Hupeh
(6). Huchow, Hangchow, and Ningpo in northern Chekiang
(7). Luchuan, Chuchow, and Wenchow district in southern Chekiang
(8). The Red Basin, especially in the south, Luchow district, Szechwan
(9). Yiyang-Paoking district in Hunan
(10). Nanchang and Poyang lake region in Kiangsi
(11). Min River region, Fukien
(12). Amoy and Kiulung river, Fukien
(13). Along the West and Bamboo rivers in Kwangtung
(14). North river valley, Kwangtung
(15). Swatow district, Kwangtung
(16). Cassia river-to-Wuchow district, Kwangsi
(17). Mengtzes in Southern Yunnan

It is impossible to gauge exactly the production of these regions, for the reason that a deal of it is diverted before it reaches the ports. Some of it is made into wares of various kinds for local retail, and the excess may be exported. The Maritime Customs take account of all bamboo, bambooware, and bamboo shoots in transit at the treaty ports. An examination of the tables from Customs reports for the last ten years, however, reveals only in a general way the movements of the material and the quantities shipped through the ports. There is still the local village trade and industries of which no possible account can be taken. The reports of the exports of bamboo to foreign countries is comprehensive and complete, it is obvious that the internal trade is but faintly indicated by the published reports. The bamboo

which comes out of southern Shensi, for instance, on its way to the large cities is shipped down the Han to Hankow where it is recorded as an import to be locally used or re-exported. What part comes from Shensi or what from other regions, it is difficult to tell. Furthermore, if one did know, the figures would not be correct, since undoubtedly a large percentage of the bamboo produced near Sianfu goes down the Wei to the Yellow river. Again, Yiyang in Hunan province is the center of a bamboo industry valued at over a million taels, the products being chiefly paper and bambooware But the Customs reports for Changsha and Yochow do not seem to indicate anything like this. The inference is that baskets, other wares, and paper made from loally produced bamboo are shipped either *via* the Siang river to Tung Ting lake and the Yangtse, touching at Changsha only for the purpose of leaving sufficient for local use and delivering the bulk at the larger port cities like Hankow, Nanking and Shanghai for use there or for re-export, or by native routes entirely under native regulation to supply the large demand in the interior cities.

Nevertheless, as we have already stated, the Customs analysis of the export trade of China indicates in a general way the movement of bamboo material and the proportional distribution among the trade centers.

If the figures for the original export of bamboo, bambooware, and bamboo shoots for the chief ports concerned be combined, the result is most interesting. The ranking of the provinces with regard to the trade in bamboo through their respective ports conforms exactly to the laws governing its distribution. This indicates the close proximity of the production and trade centers. Bamboo is more abundant on the low-lying plains and coastal regions than it is in the interior. Also, it grows more luxuriantly nearer the tropics than it does in the north. On the list below we see that Kwangtung leads the list; it is also the most southern of the coastal provinces. It is followed in due order by the three successive coastal provinces to the north. After them come the interior provinces, the southern ranking higher than the northern provinces.

Original Export of Bamboo from the Provinces through the Maritime Customs for 1923.

Valuation in Haikwan Taels

	Bamboo shoots	Bamboo etc.	Total
Kwangtung	19,113	1,229,308	1,248,421
Fukien	552,848	134,579	687,427
Chekiang	31,904	229,706	261,610
Kiangsu	15,298	179,271	194,569
Szechwan	106,551	5,842	112,393
Hunan	82,412	13,553	95,965
Hupeh	63,599	2,659	66,258
Yunnan		21,959	21,959
Kwangsi	1,701	16,769	18,470
Kiangsi	13,516	2,135	15,651
Shantung	358	4,759	5,117
Anhwei			209

The Chinese say that a country without a universally useful plant like

bamboo cannot endure. This is undoubtedly a tribute to bamboo, and we are ready to believe from our survey of bamboo cultivation in China that bamboo has added materially to the prosperity of the common people. It is all the more remarkable that during recent years, when so much that is Western has been pouring into the country, including construction materials, bamboo has not lost ground. Indeed, a glance at the tables giving the Customs valuation of the bamboo trade for the last ten years will show an average increase. The reports for the years following the outbreak of the World War do not show any considerable drop in the trade; nor was there any special spurt noticeable after the War, showing that this disturbing factor had little effect on the trade in bamboo. The export of bamboo and bamboo-ware to Hongkong in 1921 was valued at Hk. Tls. 867,700 and that to Macao Hk. Tls. 251,434. In 1922 the export to Hongkong jumped to Hk. Tls. 1,159,065, while that to Macao slumped to Hk. Tls. 209,309 going even lower the following year. There seems to be no parallelism at work, no general cause and effect operating at the same time. The trade through each port seems to be sufficient unto itself, constituting a route separate and distinct from every other route. The reasons for the falling off of trade through particular ports may be discovered in the trend of local and provincial affairs only. A group of students graduated from European and American universities return to China inspired to develop and make something out of China's resources. Being equipped with the latest scientific training and having at their command plenty of money, they launch an enterprises ni sugar cane or rubber planting. As the labor is of course drawn from the neighboring regions, no one is left to do the usual chores, and among other things bamboo-cutting is neglected. The amount exported from that particular region falls below normal, with the result that the total amount imported into and exported from the nearest port is below normal. If the said enterprises fail, as they frequently do, there will undoubtedly be a spurt in bamboo production as in other things the following year.

If it is not the diversion of energy and capital into other channels that causes a temporary decrease in the amount of business transacted, it is the much commoner and more prevalent disease of provincial warfare. These outbreaks occur so frequently and in some places with such recurrent regularity that it is difficult to predict prosperity for any trade or industry. The point is that when an outbreak does occur, the people are forced to leave their homes with their possessions if they wish to avoid losing them. Even their lives are in jeopardy. The result of this state of affairs is perfectly obvious. The trade reports of the following year for that region are indelible records of the blighting effect of the trouble, telling a gloomy story of misery and slow pauperization.

From these facts and figures, it will be gathered that the trade in bamboo is holding its own and, if anything, is bigger to-day than ever before; that despite wars, the influx of Western materials, and the general industrialization of China, bamboo is intensifying its position as the dependable staple of Chinese life.

APPENDICES

CONTENTS

—:o:—

	Page
Customs Figures of Trade in Bamboo 1914-1925.	63
Bamboos Represented in Canton Christian College Herbarium.	74
Wholesale Prices in Shanghai.	75
Acknowledgments.	76
Bibliography.	77

Table 1. Bamboo and Bambooware.

Exported to	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.
Hongkong	416,731	430,025	470,459	499,000	443,112	586,481	768,291	867,700	1,159,065	991,169	1,006,379	460,674
Macao	99,778	157,463	100,686	147,286	154,474	193,761	156,416	251,434	209,309	122,052	196,490	124,520
French Indo-China	1,406	1,200	1,045	970	792	780	805	731	1,719	1,188	1,569	8,113
Siam	138,382	147,460	138,417	96,356	76,408	103,447	120,864	185,238	151,956	156,322	141,076	125,191
Singapore, Straits, etc.	64,255	72,439	71,682	60,914	44,513	38,940	44,837	44,233	43,201	41,770	44,932	52,885
Dutch Indies	7,766	17,053	13,385	6,249	1,948	2,611	1,417	2,644	2,602	3,157	3,122	2,623
British India	1,947	3,974	569	251	149	391	843	14,532	18,904	22,061	9,503	8,940
Turkey, Persia, Egypt, Aden, etc.											98	56
Great Britain			225					476		39	709	524
France	8	20	13								168	1,072
Italy											252	182
Norway												
Sweden												
Denmark									84			
Russia, European ports	122								170	187		
Russia & Siberia by land frontier	55		40	15					86			
Russia, Amur ports	242	65	15	106	2	36		179	377	11		
Russia, Pacific ports	4,494	3,054	1,864	786	548	2,094	2,881	2,065	837	1,317	48	200
Korea	800	1,352	258	440	644	688	809	1,985	1,301	546	1,055	912
Japan (including Formosa)	3,927	2,474	3,000	2,828	2,119	5,674	5,922	10,133	12,782	43,410	70,279	55,977
Philippine Islands	2,917	2,854	1,271	3,557	105	568	1,626	2,167	2,286	2,893	3,017	4,377
Canada								41		251		
U.S.A. (including Hawaii)	99	210	289	825		19	317	2,397	6,032	16,546	5,241	15,809
Australia, New Zealand, etc.									38			
South Africa	10											
South America	64											
Germany										29		378
Netherlands												989
Belgium										45		37
Total Exported Abroad	743,003	839,643	803,218	819,583	724,814	935,490	1,105,028	1,385,955	1,610,749	1,402,993	1,483,938	863,719

Table 2. Bamboo and Bambooware

Net Import into	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.
Aigun	364	899	546	352	402		439	3,926	682	1,421	1,584	458
Sansing		860	137	178	343	20	690					
Manchouli	125											
Antung	1,391	1,525	1,838	2,118	1,674	1,361	1,145	3,234	2,455	2,633	1,235	1,232
Dairén	1,773	5,477	3,970	3,871	2,639	2,916	6,457	7,658	6,649	8,243	12,486	11,634
Newchwang	33,212	32,727	54,418	32,941	12,157	33,147	29,285	44,267	54,760	66,808	55,050	103,013
Chinwangtao	458	598	613	421	789	1,020	327	955	1,160	1,536	1,101	1,485
Tientsin	103,282	100,137	100,269	82,988	75,255	84,812	136,668	148,112	163,701	115,208	117,666	136,638
Lungkow		20	117	206	176	357	360	809	1,849	1,984	1,269	1,272
Chefoo	68,386	61,180	40,880	31,252	13,267	24,490	36,272	48,085	48,144	45,566	38,767	33,694
Kiaochow	49,915	4,416	41,376	40,636	62,843	61,357	44,025	81,337	77,118	91,334	107,927	104,631
Chungking	259	375		34					95	109	106	
Wanhsien					327	1,463	716	217		51	38	340
Ichang								159	4,813	5,643	25,936	25,517
Shasi				33	12		148		3,693	560		
Changsha	46							17	547	230	418	270
Yochow									12	18		3
Hankow	4,776	2,481	2,844	5,653	5,136	6,457	4,700	2,904			8,879	8,248
Kiukiang	415	192	28	194	5,970	30	440	195	1,110		858	1,874
Wuhu	68	115	692	313	508	147	151	124	118	88	948	1,252
Nanking	104		1,902	2,927	689	4,030	1,482	1,435	2,244	3,531	11,228	14,436
Chinkiang		17				14		129	345	74	6	1,426
Shanghai	11,888	8,396	19,765	27,361	29,766	21,431	16,967	21,789	66,817	57,179	45,974	79,056
Soochow				28				29		204	484	79
Hangchow	143		130	140	85		30		121	25	75	240
Ningpo	697	667		282	626	825	306	284	476	735	483	298
Wenchow						90	61	15		61	220	126
Santuao			16		38	77	127	198	248	456	210	210
Foochow								573	1,306	1,096	1,050	1,277
Amoy	1,915				484	1,982	3,040	2,686	4,765	3,311	3,678	3,700
Swatow	5,690	5,470	5,529	4,495	2,055	1,214	474	2,396	3,059	2,068	4,859	2,332
Canton	19,383	19,958	6,137	6,495	6,485	5,609	9,459	10,698	20,882	38,662	46,916	43,270
Samshui								155		7,026		
Wuchow	850	5,137	7,583	5,575	5,957	6,471	7,842	6,937	5,810	5,732	2,459	2,360
Nanning				116	272	52	104	121				
Kiungchow	72					5	799	530	1,120	738	1,305	700
Pakhoi											1,122	108
Excess of Re-export over import	305,212	250,647	288,789 583	248,609 474	227,955 176	259,377 472	302,514 1,164	389,974 5,492	474,099 102	462,390 132		581,249 141
Total Net import			288,206	248,135	227,779	258,905	301,350	384,482	473,997	462,258	494,337	581,108

Original Export from	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.	Val. Hk. Tls.
Harbin District								36	908	1,209	1,788	2,409
Manchouli	55		40	15								
Suifenho		133	10									
Antung	280	245	69	234	438			879	471	156	325	335
Newchwang	52	576	633	17				70				
Tientsin		39						75	240	1,005	351	288
Lungkow		63	216	12	173			100		306		50
Chefoo	3,984	5,063	2,603	2,645	1,490	4,399	4,723	2,961	1,973	4,453	2,560	982
Kiaochow			93	17		40	319	221				
Chungking									7,527	5,815	15,999	30,260
Wanhsien					29	138	232		12	27		196
Ichang									624	87		
Shasi								184				
Changsha	90	38	11					47	181	4,069	12,943	10,540
Yochow										9,484	9,093	553
Hankow		1,735	8,949						1,796	2,572	18,487	11,742
Kiukiang	3,265	4,001	5,665	2,123	1,328	751	2,131		1,415	2,135	4,566	1,429
Wuhu		15		11		11		85		202	212	678
Nanking	683	1,370	2,505	6,802	4,377	4,766	4 961	3,844	11,102	2,768	15,885	21,459
Chinkiang		38	2					136		799	4,781	1,337
Shanghai	130,792	91,730	118,017	66,987	50,180	105,900	131,612	145,218	176,225	174,114	197,531	275,433
Soochow	147	79	289	138	394	258	344	574	640	1,590	340	398
Hangchow	72,703	63,388	72,652	74,817	71,353	58,930	30,223	89,338	82,233	99,903	63,462	79,155
Ningpo	61,209	61,608	69,145	47,387	47,073	50,831	70,643	101,906	127,974	124,716	140,785	154,993
Wenchow	2,011	2,174	1,921	679	590	102	1,394	4,622	5,140	5,587	9,848	9,124
Santuao			31		102	33	118	3,583	891	69	45	84
Foochow	53,372	69,289	68,572	56,984	61,198	59,890	51,101	83,211	71,391	99,505	98,862	144,963
Amoy	49,751	36,185	39,125	26,884	18,206	26,171	17,046	24,143	24,843	35,005	45,454	31,374
Swatow	180,880	200,256	189,324	147,551	117,190	137,214	157,415	223,962	187,159	196,680	195,084	170,741
Canton	87,528	134,383	102,381	120,817	103,809	101,899	251,420	423,551	677,944	582,221	599,978	263,958
Kowloon	257,337	203,025	257,941	274,058	234,641	368,615	381,625	280,536	299,131	257,352	256,847	157,486
Kowloon (R. R. traffic)	461	490	771	2,799	4,245	7,357	15,476	17,581	49,918	4,851	236	110
Lappa	129,157	198,494	120,447	200,159	209,003	259,603	211,292	313,404	265,697	112,613	217,395	142,585
Kongmoon	6,083	8,127	40,388	11,990	9,916	9,445	23,028	22,229	18,122	75,591	36,245	17,966
Samshui	17,324	15,771	32,691	22,918	21,020	19,169	23,521	23,051	30,522	39,392	35,589	19,370
Wuchow	4,693	3,344	3,751	2,799	223	592	2,140	3,720	6,923	16,769	23,267	21,180
Nanning					75							
Kiungchow	2,429	4,892	1,363	842	414	765		1,152	818	621	1,266	5,080
Pakhoi					90		1,235	2,431	1,006	1,232	2,247	2,763
Tengyueh	90	134	53	18	38	28	174	14,421	18,790	21,959	9,149	8,446
Lungchingtsun										52		
Mengtsz	14	87									562	
Szemao	638	2,128									27	
Total Original Export	1,065,028	1,108,894	1,139,658	1,069,703	957,639	1,217,613	1,382,826	1,787,271	2,071,616	1,884,409	2,021,209	1,587,467

Table 3. Bamboo Shoots

Exported to	1914		1915		1916		1917		1918		1919	
	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.
Hongkong	10,124	67,410	10,881	80,653	8,553	55,829	6,230	36,684	6,050	43,361	8,212	48,263
Macao	526	1,578	505	1,602	892	2,515	147	715	276	1,018	114	490
French Indo-China			11	108								
Siam	65	412	128	888	115	712	49	341	66	441	131	954
Singapore, Straits, etc.	92	516	191	1,043	81	460	32	246	74	725	26	1,196
Dutch Indies	2	20	19	207	2	20	8	57			14	132
British India	22	110	9	101								
Great Britain												
France				9								
Norway												
Sweden												
Denmark												
Russia, Amur ports	10	407	7	274	6	272	1	46				
Russia, Pacific ports	148	1,531	181	1,570	92	1,943	32	663	34	805	31	742
Korea	5	100	10	126	17	326	17	325	14	266	24	267
Japan (including Formosa)	53	220	21	117	17	103	15	139	46	352	244	989
Philippine Islands	145	834	146	1,012	141	1,020	80	545	40	322	81	649
Canada												
U. S. A. (including Hawaii)												
Australia, New Zealand, etc.												
Total Exported Abroad	11,192	73,138	12,109	87,710	9,916	63,200	6,611	39,761	6,600	47,290	8,877	53,682

Exported to	1920		1921		1922		1923		1924		1925	
	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.
Hongkong	7,951	48,995	7,877	62,019	6,763	50,844	4,570	30,845	6,448	47,020	2,314	21,725
Macao	279	1,099	320	1,719	183	835	115	514	161	755	66	303
French Indo-China			4	20			1	7	1	7	47	530
Siam	136	998	226	2,010	591	4,213	198	1,439	187	1,363	248	1,846
Singapore, Straits, etc.	151	851	139	1,207	77	773	153	1,380	107	1,199	441	4,997
Dutch Indies	6	45	50	520	25	276	29	315	35	551	38	516
British India			2	40					4	74	31	422
Great Britain												
France					1	31						
Norway												
Sweden												
Denmark												
Russia, Amur ports	4	152							3	128		
Russia, Pacific ports	16	415	107	1,393	56	1,131	56	1,270	34	1,170	17	631
Korea	25	311	76	1,579	151	3,263	109	2,365	110	3,705	123	3,565
Japan (including Formosa)	94	497	206	1,842	269	2,061	168	1,205	226	1,205	129	1,220
Philippine Islands	129	896	176	1,553	191	1,655	196	1,704	231	1,931	255	2,670
Canada											18	110
U. S. A. (including Hawaii)											1,023	7,167
Australia, New Zealand, etc.												
Mexico and Central America (including Panama)											5	21
Total Exported Abroad	8,791	54,259	9,183	73,902	8,307	65,082	5,595	41,044	7,547	59,108	4,755	45,723

Table 4. Bamboo Shoots

Net Import into	1914		1915		1916		1917		1918		1919	
	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.
Aigun	9	388	32	1,068	46	520	18	396	2	70	7	95
Sansing									1	80		
Antung	51	337	22	874	48	866	15	457	24	764	17	526
Dairen	678	3,023	500	6,392	2,164	7,291	792	5,230	732	6,525	607	7,488
Newchwang	428	7,449	1,019	19,001	755	16,360	660	12,270	944	19,842	620	13,612
Chinwangtao	65	765	103	1,063	73	2,098	59	680	156	1,283	94	1,287
Tientsin	31,544	45,777	6,560	48,268	8,463	51,238	4,040	44,050	4,941	50,383	3,834	64,783
Lungkow			1	6	4	94		2				
Chefoo	428	3,751	852	7,430	378	4,358	141	2,179	413	5,590	321	6,721
Kiaochow	677	8,064	295	2,045	1,062	10,836	696	9,109	907	11,144	3,108	15,500
Chungking							1	12			8	262
Wanhsien									1	10	1	4
Ichang	102	4,131	44	986	180	1,459	68	524	141	1,925	128	2,239
Shasi	41	395	6	45	54	445	62	562	27	328	9	217
Changsha	3,949	29,832	4,562	34,815	4,640	34,905	1,366	10,495	2,992	28,888	1,919	19,098
Yochow	118	955	201	1,634	53	405	203	1,544	902	8,834	440	4,384
Hankow	44,182	347,953	32,976	258,713	43,076	338,673	19,979	172,706	30,496	323,862	30,554	321,283
Kiukiang	2,871	2,526	2,572	14,065	2,898	14,240	1,794	11,918	705	3,109	1,684	12,069
Wuhu	417	3,175	150	2,743	530	4,120	257	2,090	298	2,828	408	3,517
Nanking	600	3,776	851	7,771	625	5,402	912	7,806	637	7,738	1,053	14,800
Chinkiang	1,747	13,881	610	4,211	529	5,102	152	1,937	290	3 188	549	5,510
Shanghai	65,515	334,704	38,605	166,912	45,020	234,392	31,610	190,459	57,384	358,836	48,977	339,278
Soochow	3,834	25,311	1,060	7,240	2,798	18,810	623	5,093	2,055	17,561	2,252	21,063
Hangchow	4,849	34,591	1,992	13,950	3,366	24,058	2,794	23,975	4,070	28,745	2,407	19,100
Ningpo	437	2,846	10	35	189	1,227	49	255	396	3,355	10	88
Wenchow					161	1,080	51	198	59	112	24	110
Santuao					24	62	3	24	28	269	31	120
Foochow					689	3,812	425	2,500	663	3,709	381	3,690
Amoy	826	5,743	662	4,234	1,189	7,966	467	3,075	1,186	10,342	265	2,276
Swatow	1,327	9,800	1,352	9,882	301	1,648	76	582	373	1,891	63	506
Canton	141	935	143	1,629	161	744	3	21	68	313		
Samshui	910	4,192	143	657								
Wuchow												
Excess of Re-export over Import					119,476	791,213	67,316	510,149				
					63	1,968	15	663				
Total Net Import	165,746	894,300	95,323	615,669	119,413	789,245	67,301	509,486	110,891	901,524	99,771	879,626

Net Import into	1920		1921		1922		1923		1924		1925	
	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.
Aigun	15	457	69	3,243	5	212	26	1,186	24	1,080	18	828
Sansing	1	18										
Antung	37	562	40	1,520	68	1,049	87	2,084	27	1,004	24	779
Dairen	1,080	7,001	1,447	11,065	1,407	15,375	1,410	19,894	1,278	16,501	1,409	46,422
Newchwang	833	18,784	1,105	23,209	1,001	24,331	1,286	31,881	1,026	22,512	1,230	34,706
Chinwangtao	57	1,003	301	1,932	81	965	74	1,447	96	1,904	54	1,150
Tientsin	5,450	46,503	4,947	58,246	4,071	52,260	2,992	24,249	2,882	36,294	2,434	33,531
Lungkow							1	45				
Chefoo	462	6,958	607	10,417	595	8,448	428	8,987	507	8,445	529	8,604
Kiaochow	1,045	11,064	1,292	17,878	1,119	14,720	1,194	17,659	1,617	24,271	1,040	21,150
Chungking												
Wanhsien	99	1,673			1	44	4	134	381	5,069	187	3,259
Ichang	519	8,120	686	10,533	3,247	47,341	2,752	48,737	6,975	112,995	3,930	63,665
Shasi	149	2,056	548	7,694	3,745	45,718	5,065	55,326	3,779	31,377	3,047	35,025
Changsha	3,128	32,896	3,894	45,559	4,809	54,673	2,431	24,738	4,245	48,404	2,741	32,140
Yochow	1,586	16,570	2,066	22,809	3,208	31,105	3,686	34,591	5,372	62,062	2,773	31,958
Hankow	32,762	304,780	27,642	311,730	30,588	303,446	29,333	274,076	34,170	390,037	24,701	286,245
Kiukiang	1,867	16,701	1,884	13,243	82	929	1,891	20,801	3,040	76,000	445	10,680
Wuhu	384	4,175	495	5,414	264	2,883	264	2,903	266	3,294	158	2,026
Nanking	2,351	34,609	4,298	52,734	3,102	35,517	3,634	39,008	5,683	61,130	2,178	28,102
Chinkiang	507	5,171	512	5,668	340	3,201	433	4,488	300	4,000	368	4,539
Shanghai	57,586	356,411	66,893	382,793	54,564	277,445	41,291	230,739	57,277	448,696	34,757	259,578
Soochow	1,909	20,612	4,542	33,879	3,011	27,693	1,487	13,685	2,975	35,900	1,347	13,731
Hangchow	2,123	19,491	4,415	41,602	3,359	30,803	2,568	25,066	1,773	19,782	1,193	13,722
Ningpo	1,066	10,648	120	1,200	1	48	244	1,953	111	848	353	3,525
Wenchow			5	31	47	291	5	35				
Santuao	19	54			57	260	44	292	25	88	1	10
Foochow	15	35			100	1,015			15	159	7	32
Amoy	468	3,838	806	5,713	568	5,433	556	4,975	497	5,647	397	7,027
Swatow	397	4,755	1,356	13,239	1,698	16,195	1,523	11,828	883	9,574	153	1,805
Canton	522	2,253	108	989	349	2,006	175	1,921	1,480	6,607	87	1,369
Kongmoon							4	14	2	25		
Samshui	144	661			10	45	1	12	53	242		
Wuchow												
Excess of Re-export over Import	116,581 21	997,859 667	130,078 31	1,082,340 1,179	121,497 8	1,003,451 438	104,889 39	902,754 1,003	136,741 18	1,432,011 419	85,561 9	945,608 270
Total Net Import	116,560	997,192	130,047	1,081,161	121,489	1,003,013	104,850	901,751	136,723	1,431,592	85,552	945,338

Table 5. Bamboo Shoots

Original Export from	1914		1915		1916		1917		1918		1919	
	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.
Harbin District												
Antung												
Newchwang					11	74						
Tientsin												
Lungkow												
Chefoo					11	157	10	127	15	185		
Kiaochow												
Chungking	4	62	19	294	15	164	70	1,175	28	479		
Wanhsien												
Ichang												
Shasi			4	26					22	89		
Changsha	2,352	45,737	2,148	59,082	2,113	62,727	1,525	46,667	2,786	85,441	1,792	67,574
Yochow			3	85			5	244	268	3,462	13	156
Hankow	463	2,834	748	9,315	241	6,033	234	9,888	226	5,393	2,044	45,078
Kiukiang	625	6,710	544	6,540	264	5,138	197	2,532	367	6,118	1,074	12,712
Wuhu	5	36			43	219	3	10	7	44		
Nanking			22	134	2	12	3	30	1	9		
Chinkiang	46	313	122	961					11	113	2	37
Shanghai	584	2,983	1,130	5,710	1,219	5,926	2,102	11,056	882	4,439	1,053	6,084
Soochow			1	36								
Hangchow	169	1,873	312	3,473	4,790	16,868	242	2,356	235	2,594	259	2,486
Ningpo	5,951	7,810	4,813	8,125	8,761	14,813	10,611	20,812	8,691	16,656	10,793	21,097
Wenchow	387	1,167	109	324	229	647	586	3,076	419	1,249	332	1,472
Santuao					22	50			69	155		
Foochow	130,077	845,489	89,863	560,847	98,175	685,451	56,364	442,281	88,515	776,288	89,554	769,178
Amoy	223	1,214	391	1,922	165	1,228	217	1,002	174	1,272	253	1,324
Swatow	144	805	130	684	149	694	65	425	109	566	129	1,825
Canton	2,079	8,530	2,377	9,728	4,138	17,463	3,403	17,733	3,026	12,954	5,263	24 794
Kowloon	4,198	29,385	1,752	19,803	1,052	11,888	396	3,958	506	5,059	305	1,980
Kowloon (R. R. traffic)	31	217	117	330	177	499	3	8	3	6	23	63
Lappa											7	16
Kongmoon	79	304	148	331	745	1,719	922	2,123	63	194	859	2,039
Samshui	151	1,413	241	1,477	504	4,335	195	1,403	137	1,170	205	1,371
Wuchow					523	4,054	6	34	439	2,257		
Kiungchow												
Pakhoi												
Tengyueh												
Total Original Export	147,577	947,035	105,008	689,455	123,349	840,159	77,159	566,940	106,999	926,192	113,987	959,672

Original Export from	1920		1921		1922		1923		1924		1925	
	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.	Piculs	Val. Hk. Tls.
Harbin District					2	70	2	70	16	433	13	392
Antung			1	12	1	11						
Newchwang												
Tientsin					9	380			3	102	14	718
Lungkow												
Chefoo			54	833	71	990	30	358	8	296	14	417
Kiaochow									24	109		
Chungking			920	15,803	8,325	120,049	8,868	106,551	7,671	108,228	6,276	114,319
Wanhsien												
Ichang							169	3,485				
Shasi									42	516	3	44
Changsha	1,067	40,362	1,596	61,262	1,294	49,006	3,341	73,045	2,999	55,704	1,713	58,521
Yochow	63	1,222	72	2,695	41	148	275	9,367	177	3,249		
Hankow	1,099	35,130	1,346	46,502	1,592	46,903	2,120	60,114	1,954	43,654	1,506	57,109
Kiukiang	839	11,020	955	8,492	998	7,066	1,554	13,516	2,492	23,989	1,019	9,431
Wuhu			19	142	2	34	1	7	1	11		
Nanking	6	63									17	94
Chinkiang												
Shanghai	1,268	6,844	1,482	7,606	1,827	13,881	1,705	15,298	1,429	10,283	596	6,196
Soochow												
Hangchow	223	2,234	675	7,552	430	3,712	339	5,522	225	4,089	293	6,078
Ningpo	18,878	26,109	29,656	38,608	25,208	32,823	16,744	23,797	21,334	35,932	14,632	24,496
Wenchow	485	2,300	256	1,261	686	3,120	586	2,585	658	3,128	2,378	10,619
Santuao	153	431	100	292	245	1,209	825	3,311	529	2,109	313	1,251
Foochow	99,825	921,271	96,081	870,077	99,314	826,378	66,619	544,187	107,116	1,117,690	63,391	685,031
Amoy	312	2,031	562	3,672	310	2,027	1,037	5,350	415	2,566	1,593	8,175
Swatow	144	901	187	1,189	504	3,593	63	450	193	1,369	112	806
Canton	5,050	24,356	3,158	15,769	3,084	15,202	2,758	13,700	3,644	19,963	2,130	12,915
Kowloon	298	1,937	217	1,732	359	2,872	213	2,130	235	2,233	311	2,955
Kowloon (R. R. traffic)	14	84	22	94	52	169	9	18				
Lappa	54	117	173	885	37	155	5	20	27	126	14	65
Kongmoon	865	1,864	166	409	97	220	12	78	12	58		
Samshui	233	1,728	638	4,030	198	2,305	380	2,717	185	2,045	92	655
Wuchow			101	824	394	1,937	216	1,701	1,601	7,153	143	1,200
Kiungchow												
Pakhoi												
Tengyueh												
Mengtsz											4	88
Total Original Export	131,706	1,094,257	138,446	1,089,741	145,080	1,134,260	107,871	887,377	152,990	1,445,035	96,577	1,001,575

Table 6. Bamboo Trade Through Shanghai

1923

Articles		Imports from China	Re-exports to China	Re-exports to Abroad	Net total Chinese imports Quantity	Net total Chinese imports Val. Hk. Tls.
Bamboo brooms	pieces	2,242,433	1,597,814	—	644,619	14,857
" penholders	piculs	8,884	8,218	—	666	2,407
" poles	Val. Hk. Tls.	17,941	10,416	1,403	—	6,122
" shoots	piculs	60,385	18,952	142	41,291	230,739
" small	Val. Hk. Tls.	1,715	10,229	—	—	8,514
" split, leaf, etc.	piculs	22,365	5,915	4,179	12,271	41,712
Bambooware	"	396	368	—	28	595

Articles		Exports to Foreign countries	Exports to Hong-kong	Exports to China	Re-Exports	Total Exports Quantity	Total Exports Val. Hk. Tls.
Bamboo brooms	pieces	2,940	—	1,883,107	1,597,814	3,483,861	119,651
" penholders	piculs	—	—	568	8,218	8,786	33,537
" pipe-stems	"	—	—	530	—	530	2,991
" poles	pieces	216,319	9,200	53,991	96,875	376,385	29,809
" shoots	piculs	102	5	1,598	19,094	20,799	243,634
" small	pieces	—	—	1,229,560	310,931	1,540,491	18,436
" split, leaf, etc.	piculs	324	12,616	7,893	10,094	30,927	94,882
Bambooware	piculs	270	58	535	368	1,231	19,910
	Val. Hk. Tls.	17,391	136	3,501	—	—	21,028

1924

Articles		Imports from China	Re-exports to China	Re-exports to Abroad	Net total Chinese imports Quantity	Net total Chinese imports Val. Hk. Tls.
Bamboo brooms	pieces	1,723,443	1,021,909	—	701,534	18,559
" penholders	piculs	2,044	2,057	—	13	81
" poles	Val. Hk. Tls.	13,201	11,149	—	786	1,266
" shoots	piculs	84,683	27,239	167	57,277	448 696
" small	Val. Hk. Tls.	11,841	10,824	—	—	1,017
" split, leaf, etc.	piculs	24,636	6,843	7,476	10,317	23,123
Bambooware	"	555	447	11	97	2,090

Articles		Exports to Foreign countries	Exports to Hong-kong	Exports to China	Re-Exports	Total Exports Quantity	Total Exports Val. Hk. Tls.
Bamboo brooms	pieces	6,522	—	1,336,200	1,021 909	2,364,631	83,552
" penholders	piculs	—	—	3,168	2,057	5,225	23,957
" pipe-stems	"	—	—	151	—	151	1,026
" poles	pieces	10	—	28,533	112,442	140,985	16,412
" shoots	piculs	144	462	823	27,406	28,835	357,288
" small	pieces	—	—	948,318	275,337	1,223,655	18,887
" split, leaf, etc.	piculs	539	9,215	21,366	14,319	45,439	151,919
Bambooware	piculs	485	115	477	458	1,535	24,868
	Val. Hk. Tls.	—	—	31,724	—	—	31,724

Articles		Imports from China	Re-exports to China	Re-exports to Abroad	Net total Chinese imports Quantity	Net total Chinese imports Val. Hk. Tls.
Bamboo brooms	pieces	2,399,012	1,195,436	300	1,203,276	34,206
" penholders	piculs	2,658	2,163	—	495	1,930
" poles	Val. Hk. Tls.	22,755	23,976	—	—	1,221
" shoots	piculs	52,864	17 585	522	34,757	259,578
" small	Val. Hk. Tls.	27,969	11,520	—	—	16,449
" split, leaf, etc.	piculs	20,394	10,259	3,945	6,190	26,040
Bambooware	"	830	662	79	109	1,652

Articles		Exports to Foreign countries	Exports to Hong-kong	Exports to China	Re-Exports	Total Exports Quantity	Total Exports Val. Hk. Tls.
Bamboo brooms	pieces	—	—	778,876	1,195,736	1,974,612	65,421
" penholders	piculs	—	—	1,086	2,153	3,249	14,413
" pipe-stems	"	—	—	175	—	175	1,246
" poles	pieces	—	—	56,786	214,140	270,926	32,918
" shoots	piculs	68	—	528	18,107	18,703	262,892
" small	pieces	—	—	1,298,155	306,625	1,604,780	30,595
" split, leaf, etc.	piculs	41	13,893	60,231	14,204	88,369	195,784
Bambooware	piculs	35	8	2,844	741	3,628	51,660
	Val. Hk. Tls.	—	—	34,899	—	—	34,899

Bamboos Represented in Canton Christian College Herbarium

by F. A. McClure, U. S. D. A.

Assistant Professor of Botany, Canton Christian College.

Scientific Name	Locality (Kwangtung)	Chinese Name	Characters
Bambusa beechyana Munro	Honam Island	*San Chuk*	新竹
	Canton, White Cloud Mt.	*Shik Sun Chuk*	食筍竹
Bambusa multiplex (Lour) Reausch	C. C. C. Campus	*Kun Yam Chuk*	觀音竹
	Chuk Uen, Nam Hoi	*To Fa Chuk*	桃花竹
	Same	*Chang Ko Chuk*	撐篙竹
	Tak Hing	——	
	Hainan	*So Pa Chuk*	掃把竹
Bambusa oldhami Munro	Honam Island	*Chuk Sun*	竹筍
	Hainan Island	*Nai Chuk*	坭竹
	Same	*Shek Chuk*	石竹
	Honam Island	*Tai Tau Tim Chuk*	大頭典竹
Bambusa spinosa Roxb. (B. blumeana Schultes)	Honam Island	*Lak Chuk*	簕竹
	Same	*Pak Chuk Fa*	白竹花
	Hainan Island	*Nai Chuk*	坭竹
	Same	*Shek Chuk*	石竹
	Same	*Shui Chuk*	水竹
	Same	*Lak Chuk*	簕竹
	Same	*Tai Lak Chuk*	大簕竹
Bambusa stenostachya Hack	Same	*Lak Chuk*	簕竹
	Honam Island	——	
	Hainan Island	*Tsz Chuk*	刺竹
	Same	*Wat Chuk*	鼈竹
Bambusa tuldoices Munro	Honam Island	*Pat Chuk*	筆竹
	Tai Yeung Shaan	*Kwai Chuk*	鬼竹
Bambusa vulgaris Schrad	She Haang	*Ma Chuk*	蘇竹
	C. C. C. Campus	——	
Phyllostachys bambusoides	Ying Tak	——	
Phyllostachys rigra	Loh Fau Mt.	——	
Dendrocalamus latiflorus Nees	Hainan Island	*Tsing Ma Chuk*	正蘇竹
	Same	*Ma Chuk*	馬竹
	Same	*Nai Chuk*	坭竹
Dendrocalamus strictus	Ying Tak	——	
Arundinaria sp	Loh Fau Mt.	*Tai Ngaan Chuk*	大眼竹
	Ying Tak	——	
Schizostachyum hainanense Merr sp nov	Hainan Island	*Tang Chuk*	藤竹

Wholesale Prices in Shanghai

The following list shows wholesale prices in Shanghai on March 15, 1925, of articles of bambooware in general demand:

English Names	*Chinese Names*	*Chinese Currency*
Water Bottle Basket	水瓶籃	$ .98
Sandwich Basket	雜物籃	$ .36
Tray Basket	盤 籃	$ .80
Ball Basket	球 籃	$ .51
Waste Paper Basket	字紙簍	$ .58
Fruit Basket	水果籃	$ .36
Gardinier	花園籃	$ .50
Work Basket	工人籃	$ .80
Chair	椅 子	$ 2.11
Table	臺 子	$ 2.11
Screen	屏 風	$ 4.00
Bamboo Vase	花 瓶	$ .12
Cake Basket	餅 籃	$ .19
Flower Basket	花 籃	$ .25
Flower Pot	花 盆	$ .445
Travel Basket	旅行籃	$ 1.60
Bucket	水 桶	$ .96
Clothes Basket	衣 籃	$ .384
Picnic Basket	野飲籃	$ 1.18
Tea Basket	茶 籃	$ 4.25
Oval Basket	長園籃	$ .13
Food Basket	飯 籃	$ .45
Food Cover	飯 罩	$ .32
Market Basket	市 籃	$ .13
Sweet Basket (For Sweets)	糖果籃	$ 5.18
Cake Stand	餅 架	$ .864
Egg Basket	蛋 籃	$ .64
Round Basket	圓 籃	$ .57
Open Work Basket	空工籃	$ .45
Closed Work Basket	密工籃	$ .20
Cylindrical Basket	螺旋籃	$ .45
Sewing Basket	縫 籃	$ 1.92
Suit Case	衣服箱	$ 2.00
Partitioned Basket	開花籃	$ 1.31
Boat-Shaped Basket	船式籃	$ 1.12
Basin Basket	洗面籃	$ .32
Light Globe Basket	地圓籃	$ .92
Flock Holder	鷄鴨器	$ .80
Washing Basket	洗衣籃	$ .20
Open Work Square Basket	開工方籃	$ .80
Closed Work Square Basket	閉工方籃	$ .512

ACKNOWLEDGMENTS

We wish to acknowledge the personal aid rendered by the investigators of the Chinese Government Bureau of Economic Information in Foochow, Nanking, Nanning and Wuhu, and Customs and Consular officials.

We wish also to thank the following for information supplied:

Right Rev. A. A. Gilman	Wuchang, Hupeh
Mr. H. S. Fauske...	Fancheng, ,,
Prof. Arthur Paul Jacot	Tsinan, Shantung
Dr. Benjamin Harding	Ichow, ,,
Dr. Jacob McF. Gaston	Laichow, ,,
Rev. H. Mathews	Yenchow, ,,
Mr. A. L. Carson	Weihsien, ,,
Mr. Peter Ratzlaff	Tsaochow, ,,
Mr. H. J. Mason	Kwangchow, Honan
Mr. R. M. Lewis	Kaifeng, ,,
Rev. Olaf Espegren	Nanyang, ,,
Mr. H. G. Thompson	Paoning, Szechwan
Mr. C. Bromby	Kweichow, ,,
Mr. H. W. Funnell	Suiting, ,,

We should like also to express our appreciation to Prof. H. C. Meng, Director of Chinese at St. John's University, to Mr. Y. T. Chu, instructor of Biology of the same University, and the students who gave us useful information concerning bamboo in their respective home regions.

1. **Ball, J. D.:** *Things Chinese.* Sampson, Low, Marston & Co., Ltd. London, 1900.

2. **Camus, E.G.:** *Les Bambusees.* Paul Lechevalier. Paris, 1913.

3. **Chinese Government Bureau of Economic Information:** Bulletins No. 168 and 192.

4. **Chang, F. L.:** *Some Chinese Trees and Tree Products.* China Journal of Science and Arts, vol. II, No. 6. Nov., 1924.

5. **Dingle, E. J.:** *New Atlas and Gazetteer of China.* Shanghai, 1917.

6. **Fairchild, D. G.:** *Japanese Bamboos and their Introduction into America.* U. S. Dep. of Agricult., Bureau of Plant Industry, Bulletin No. 43.

7. **Forbes and Hemsley:** *Index Florae Sinensis.*

8. **Freeman-Mitford, A.B.:** *The Bamboo Garden.* London, 1896.

9. **Henry, Aug.:** *Notes on the Economic Botany of China.* Shanghai, 1893.

10. **Laufer, B:** *Sino-Iranica.* Chicago, 1919.

11. **Lock, R. H.:** *On the Growth of Giant Bamboos with Special Reference to the Relation between Conditions of Moisture and Rate of Growth.* Ann. Roy. Bot. Gard. vol. II, pt. 2.

12. **Reports of the Maritime Customs of China for 10 Years.**

13. **Meyer, H. F. and Ekelund, B.:** *Tests on the Mechanical Properties of Bamboo.* Shanghai, 1923.

14. **Porterfield, W. M.:** *A Further Account of Phyllostachys quadrangulari*, Chinese Recorder, Jan., 1925.
What is Bamboo? China Journal of Science and Arts, vol. III, No. 3.

15. **Rhodin, C. T.:** *Notes on the Flora and the Reafforestation Possibilities of the Province of Chekiang.* Shanghai, 1924.

16. **Seifriz, William:** *The Length of the Life Cycle of a Climbing Bamboo.* American Journal of Botany. March, 1920.

17. **Shaw, Norman:** *Chinese Forest Trees and Timber Supply.* T. Fisher Unwin, 1914.

18. **Werner, E. T. C.:** *A Descriptive Sociology of the Chinese.* Williams and Margate. London, 1910.

19. **Wilson, E. H.:** *A Naturalist in Western China.* Doubleday, Page, & Co.

20. **Wilson, E. H.:** *Plantae Wilsonianae.*